THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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HELPING SMOKE PREVENTION.

IT is generally agreed that the atmospheric conditions in British towns are worse than in those of other countries, and that much preventable disease, discomfort, and expense is thereby caused. It is probable that most of the smoke to which these conditions are due comes from the domestic consumption of soft coal in open grates; and it is certain that the abolition of domestic smoke, having been accomplished in other places, can be accomplished here.

There are several means by which the domestic processes in which heat is required can be carried on smokelessly. Anthracite, coke, gas, and oil can be adapted for general heating, cooking, and the provision of hot water. It is possible to equip a town house very comfortably with anthracite stoves in the hall and the dining-room, a slow-combustion coke and rubbish-burning stove in the kitchen for hot water, gas fires in the drawing-room, the study, and the bedrooms, and a gas cooker for meals. A house so equipped is no rarity, and most people will be able to recall several instances within their own knowledge. In Manchester, where gas cookers and fires are installed free, a nominal annual rental being charged for each gas fire and nothing at all for the cooker, the use of gas for cooking is practically universal. All these methods mark a great advance over the crude burning of bituminous coal in open fireplaces for heating, and in a kitchen range for cooking and providing hot water. But electricity possesses even more advantages than, and none of the attendant disadvantages of, any of them.

Electricity is effective, adaptable, and completely under control. It is clean, leaves no ash, and makes no smell. It does not escape and cause loss of life. Yet with all its advantages, beyond dispute though they be, it is unusual to find a house with more than, say, an iron in the kitchen and a small radiator in the drawing-room or one of the bedrooms. Why is it not in more general use for other purposes than lighting? Even those who may reasonably be supposed to believe in the paramount claims of electricity for all household purposes, the electrical engineers who design, or manufacture, or sell the apparatus, or who generate or distribute the energy—even they make, in general, far too little use of domestic electricity.

Even in the United States, which is so often held up as an example of electrical development, the domestic field is but sparsely cultivated. The *Electrical World* of April 7th remarks, in an editorial, that "it is only in recent days that the residential customer has been considered much more than a user of some light and some appliances. . . . That lighting is still considered the principal home use of electricity is shown by the fact that the average residential bill is still under $30 per annum!"

Why do not electrical men use electricity, exclusively, for all purposes, in their own homes? The answer to this question is that the apparatus itself is too expensive. First it is necessary to wire to the points at which the appliances are to be used, and this costs money. Some gas supply authorities will run the gaspipes wherever they are wanted, and charge nothing for doing so; what electricity authority gives a corresponding service? Gas cookers in some cases are loaned free of charge, but electric cookers, which are far more expensive, have to be bought. It is possible to hire them in

a few supply areas, but these must still be considered exceptions to the rule. Electric washing machines are very convenient, but they are dear. Electric kettles, grills, toasters, vacuum cleaners, sewing-machine motors, shaving pots—in fact all the ingenious devices that have been put on the market, are handy and useful. They save trouble, and they give pleasure—but they cost a lot of money.

It has been suggested that, in order to produce a large number of living examples of electric homes, which by their advertising value would be the best means of extending the use of electricity in the household, manufacturers and electricity supply undertakings should help to finance those most affected by the question—the engineers and salesmen. There is certainly a great deal in the suggestion, and there can be no doubt that what the ordinary consumer, even if he be wealthy, wants to see is the apparatus in actual use in the conditions in which they will have to be used, not in a showroom or demonstration kitchen. If they were to be seen in a friend's house, and if that friend could say that the installation and the apparatus could be obtained on hire, or even by hire-purchase, and that the cost was not so great as was supposed, while the food was excellently cooked with less waste, and that the cleaner really cleaned the carpets, and that there was always plenty of hot water—if all this could be done, people would burn with the desire to have them in their own houses.

What is needed is that it shall be made *easy* for the ordinary individual to get the appliances he wants. At present he can get them, but it is not easy to do so. It is difficult because of the expense. Electricity supply authorities should do all that they can to remove this obstacle by providing the apparatus on hire or hire-purchase at the lowest possible rates, besides facilitating their use by the adoption of a suitable tariff.

The Budget.

We find little cause for enthusiasm in the first Budget of Mr. Stanley Baldwin. He had a great opportunity of helping trade and industry, and he has missed it. Here a little and there a little seems to be his policy—doing things by halves. A half a shilling off the income tax instead of a whole one. A half the Corporation Tax to be taken off as from the end of the present half-year so that little benefit will be felt until the first half of 1924. Beer, on the other hand, is *immediately* reduced, and will cost the consumer one penny per pint less, but the prosperous brewers are to contribute less than they should do, and the State more, to bring about that reduction which will increase consumption. We anticipate no good psychological effect upon industrial relationships of a penny beer reduction. Taxation reduction, when done in a wholehearted way, could more directly assist trade revival and therefore employment and industrial content than half-hearted tax reduction and a remission to all the drinkers of beer, cyder, lemonade and ginger-pop. The reduction in Corporation Tax is, we trust, a half-way step in the direction of abandonment of an impost which never would have been introduced if reasonable regard had been paid to the industrial character and needs of these islands, but we should like a definite date to be fixed *now* for its complete disappearance. Let it be remembered that five years after the Armistice of November, 1918, the standard rate of income tax will still be 4s. 6d. in the £, while for the privilege of carrying on trade or industry, if one succeeds in making profits, a further 6d. (Corporation Tax) in the £ is required, and other onerous burdens and restrictions are imposed upon private firms and companies which prevent them from strengthening the resources of their enterprises for business stability and development purposes. The small changes in postal, parcels, and telephone rates are, of course, welcome, and much can always be said in favour of debt redemption, but we are only re-echoing the sentiments of business and industrial authorities when we repeat our remark of recent weeks that adequate tax remission was just now more necessary than debt redemption. As matters stand, we must be thankful for such favourable changes as are to be introduced, and look forward to next year for the complete removal of the Corporation Tax, and to next year and the years that follow for successive income tax and other reductions. We are less concerned with opinions as to whether our trade can bear the reduced burdens and still make a profit than we are with the necessity for doing our utmost, not the half of it, to give that feeling of freedom from restraint which shall permit full activity in industrial and commercial life which would go so far to make for national contentment and future security.

Broadcasting Licences.

During the week little progress has been made towards solving the problem of the third man. The B.B.C. proposed a licence to cost £1, of which 15s. would go to the company, and in view of the circumstances we think this would have been a reasonable arrangement; however, the Postmaster-General would not agree to a higher fee than 10s., of which sum half would be paid to the company, and according to our latest information the company decided to accept this figure, subject to the terms of the licence being otherwise in accordance with the existing agreement. The company, in making this concession, is naturally anxious to ensure that a fair proportion, at least, of the components used by the amateur constructors shall be manufactured by its constituent firms, and to that end is standing out for a stipulation that certain parts shall be stamped "B.B.C." It holds that up to the present the rights accorded to it by the agreement in return for its outlay and service have not been secured, and this contention cannot be refuted. Unfortunately the Postmaster-General, who appears to regard with some disfavour the agreement that was signed by his predecessor, insists on the licence being made unconditional, holding that the company would be amply remunerated by its share of the fees; and he threatens, if the company does not submit to his decree, to issue "experimental" licences to the 40,000 applicants who are awaiting them—in which event the company will get nothing. Hence a deadlock has arisen.

Whilst sympathising with the company, we cannot help recalling a proverb about a long spoon; the difficulty of obtaining fair and just treatment at the hands of a Government department is sufficiently notorious, and the company must have been aware of the risk it ran in this respect. We hope, however, that the continued development of the broadcasting business will indirectly provide an adequate reward to the member firms for their public-spirited enterprise. The Press attack upon the present system is fittingly dealt with by a contributor elsewhere in this issue. It has been stated in the *Daily Express*, on the authority of a King's counsel, that licences for "listening-in" are illegal, because the Act of 1904 relates only to "the transmission of messages." Let no one put his faith in this dictum. A code of laws which permitted the Post Office successfully to claim that telephony was telegraphy will not be found lacking in resource when it is desired to show that "transmission" includes reception.

Recurring to the national radio conference in the United States, the *Electrical World* of March 31st contains in outline the recommendations resulting from its deliberations. In the main, these relate only to the wavelengths employed; whereas hitherto all broadcasting has been concentrated on three wavelengths, namely, 360, 400, and 485 metres, it is now proposed that the range shall be extended to the limits 222 and 545 metres by releasing a wide band of wavelengths reserved by the Government. Class A (high-power) stations will have the range 288-545 m., and Class B (low-power) stations that from 222 to 286 m. Class A will embrace some 50 distributed stations, powerful enough to cover the United States, while Class B numbers more than 500. It is proposed also to allot to amateurs the

range from 150 to 222 m., and to restrict the use of wavelengths under 600 m. by ships. The grip of national control is visibly tightening over the Hertzian waves, and it is hoped that the result will be to bring order out of chaos.

The Government and Inter-Imperial Trade.

A useful discussion took place in the House of Commons last week on the extension of trading operations between the Mother Country and the other parts of the British Empire, and the development, in complete co-operation with overseas authorities, of the resources of that Empire. As we have comparatively recently given attention to these important matters, there is less need at this particular moment for us to show the world responsibility that rests upon us for developing the vast resources of the lands that bear our name and the advantages that should accrue therefrom to the population of these islands, than to consider the attitude of the present Government as stated by the President of the Board of Trade (Sir P. Lloyd-Greame) in replying to the discussion.

The Economic Conference that meets in October this year, and at which all the Dominions will be represented, is intended to be a practical one which shall achieve a more definite result than the mere passage of pious resolutions. The Dominions are our best customers, and everything in reason should be done to continue and extend inter-Imperial trading relations. Sir P. Lloyd-Greame mentioned the serious deficit that exists in our export trade, and urged the necessity for wiping out this deficit and turning it into advance on previous returns as "the only cure for unemployment." Not only must our old markets be restored, but new ones must be found, and he expressed the conviction that nowhere could we find them half so quickly, so safely, or so well as in the Dominions of the Empire. Inasmuch as overseas trade conditions to-day are very different from what they were in the old days, owing to the keen competition of other manufacturing and exporting peoples, it is not to be supposed that we can achieve the progress that is desired by allowing trade to take its own course. The Dominions markets are not investigated and worked nearly as energetically as they might be by British interests, and the President holds that we could greatly increase the volume of our trade with them if we devoted our attention to them more assiduously. In our humble opinion the speaker was perfectly right in this. He did well also to intimate that the development of the Trade Commissioner Service, to which we have referred on several occasions, was one means for developing Empire markets. It has marked limitations, but whether that be so or no and whether those limitations can be removed or not, it must remain the fact—whatever the Economic Conference may *resolve* or may actually *do*—that our manufacturers and traders will be compelled to act for themselves in this matter. We once thought that manufacturers acting in co-operation would be able to achieve better results by united action. It seems, however, that only along a small part of the way can they go hand in hand. Limited and varied groups may do something, but the general band of manufacturers can do little beyond information collection and propaganda work by united effort. It is individual initiative and enterprise that will secure the business, but that plant will be the hardier and bear more luscious fruit as well if it can feed on an atmosphere of Dominion and Home encouragement as the outcome of a definite Empire trade and resources development policy.

Sir Philip Lloyd-Greame closed his speech by assuring the House that the Government would co-operate with the Dominions in schemes which would accelerate development, which would give facilities for emigration, and which would lead to a general development of inter-Imperial trade. There is an excusable disposition to become tired of conferences at which there is so much talk with so little real tangible result, and experience sometimes makes one doubtful concerning the real meaning of that blessed word "co-operation," whether among peoples or among sections of a trade. But we will hope profoundly for something better to result from the conference which assembles in London on October 1st. If the Mother Country and the Dominions can come to definite agreement, adopting and carrying out expeditiously a large and enterprising policy, and if manufacturers and traders play their great part too, the future of inter-Imperial trade should be brilliant. There is no doubt about the co-operation of the Trade Press. It occupies a position unique in its possibilities, and cannot be superseded even were anybody to desire such a thing.

Daylight Illumination.

Electrical engineers are not as a rule concerned with the exact planning of access of daylight into buildings, which was discussed before the Illuminating Engineering Society on March 27th. But the subject is of considerable general interest and merits some attention from those concerned with electric lighting, in view of the fact that natural lighting is commonly regarded as the ideal, and divergences therefrom are sometimes put forward as ground for criticism. In reality, while it may be admitted that the human eye has been developed in order to utilise outdoor daylight to the best advantage, indoor natural lighting in many buildings is very far from ideal. A study of the paper by Messrs. P. J. and J. M. Waldram will show how enormous are the variations in daylight, as compared with the comparative constancy of electric light. Again, while it is usually possible to avoid variations in artificial illumination of more than 25 to 30 per cent. at different points in the room lighted, daylight may often diminish to less than 1 per cent. of that available near the window, as one recedes to the further part of the room. It is often said that daylight "costs nothing," but we believe it was argued in a recent paper before the American Illuminating Engineering Society that the investment value of providing windows and the costs of cleaning make the running expenditure in many buildings comparable with the cost of artificial light. Indeed, in some buildings in congested areas it is conceivable that efforts to secure access of daylight into the lower rooms may ultimately be regarded as hardly worth while. The paper was most interesting as showing how much care and scientific effort is now being expended on the predetermination of daylight illumination—a matter of considerable complexity. But it is evident that we have still a long way to go before we can reach the degree of precision that has been attained with modern artificial illumination.

Gennevilliers Power Station.

In the following pages we give some details of the interesting 40,000-kW alternators supplied to the Union d'Electricité by the Société Alsacienne, which, we learn, have already been proved capable of carrying a load of 55,000 kVA. Their design is noteworthy for the high internal reactance secured largely by the artificial increase of the magnetic leakage of the stator slots, so that the short-circuit current is limited to about four times the normal full-load current. The slot adopted is closed by a thin bridge which greatly increases the strength of the teeth, and completely eliminates harmonics due to the latter; the bridges do not heat, owing to their excellent cooling by the ventilating current of air. Only during the short-circuit test was strong heating observed, in the bridges close to the ends of the stator, and this was easily remedied by cutting them in those positions. It was noticed also that, on short circuit, the core disks near the stator ends were hotter than those nearer the centre, but this condition disappeared when the machine was running on load—a phenomenon which was first mentioned by Dr. S. F. Barclay in his I.E.E. paper in 1918.

In a later issue we shall give some particulars regarding the results of tests on these alternators.

LARGE TURBO-ALTERNATORS AT GENNEVILLIERS.

The 40,000-kW Alternators of the Soc'été Alsacienne.

In our issues of April 14th and July 21st last year, we published descriptions of the plant installed at the new power station of Gennevilliers for the supply of Paris and its surroundings; we have now received from the Société Alsacienne de Constructions Mécaniques de Belfort, which built three of the five 40,000-kW sets, particulars and photographs of its machines, which we reproduce herewith. We are informed that the first of these sets has now been in service for nearly a year, the second and third being installed in July and October respectively, and that all three have given entire satisfaction.

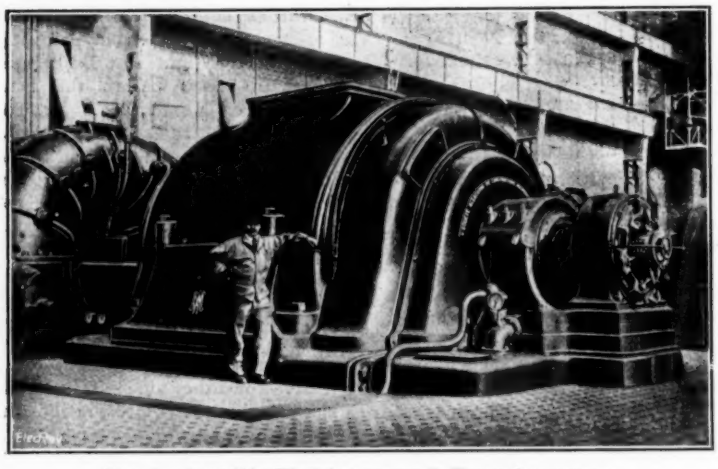


Fig. 1.—A 40,000-kW "Alsacienne" Turbo-Alternator.

These alternators deliver three-phase current, between 5,500 volts and 6,400 volts; the frequency is 50 cycles, and the speed 1,500 r.p.m. Their normal output is 40,000 kW, with a power factor of 0.9, but they have already operated at 50,000 kVA, and the tests have shown them capable of maintaining a continuous load of 55,000 kVA. The makers claim that they are the most powerful machines yet built with four poles, and develop more power per pole than any other.

The makers have sought to obtain the greatest strength, electrical and mechanical, in the construction of these machines, assuring perfect security of working. Their design was largely influenced by the condition, imposed by the Union d'Electricité, that, without the use of reactance coils, the instantaneous value of the short-circuit current should not be greater than four to five times that of the normal current, which condition has been easily fulfilled. Figs. 1 and 2 respectively show a set in course of erection and complete, and figs. 3 and 4 are longitudinal and transverse sections of the alternator.

The rotor core is built up from high-permeability steel core plates, 4 mm. thick, riveted together in packets which are shrunk on to the shaft; the rivet-heads give a certain spacing between these packets, thus forming the ventilation ducts. The packets are clamped between two steel end plates. The winding is in 48 slots, and two empty slots are arranged at the centre of each pole to limit the flux-emission from this part, in order to obtain a suitable field-form.

The field-winding consists of 138 turns per pole, or 23 conductors per slot; the normal excitation current being 470 amps. on load, each pole is capable of producing 65,000 ampere-turns. The resistance of the field-winding, when hot, is 0.48 ohm, which corresponds to an excitation voltage of 225 volts. The field coils are held in the slots by bronze wedges, connected together by means of two copper disks; the squirrel-cage thus made forms a powerful damper.

The end portion of the winding is held by end-bells of nickel-chrome steel, with an ultimate strength of 90-100 kg/mm², and an elongation of 16 per cent.; these end-bells are centred on one side on the end-plates themselves, and on the other on a forged steel end-ring, carrying the fan. The end-ring is fitted to the shaft by a bayonet-locking device.

The ventilating air has two distinct circuits: in one it enters the rotor by slots milled in the shaft, from which it is distributed to the ventilation ducts; in the other it enters by holes drilled in the fan-retaining plate, and, circulating in the end part of the windings, exhausts through slits in the tightening end-plates. The consumption of air for the ventilation of the rotor alone is 13 m.³ per second.

The critical speed is considerably above the normal speed of rotation, so that, even in the case of overspeed, there is no chance of vibration. The total weight of the rotor is about 50 tons. The stator core-plates have a loss of 2.6 watts/kg. at 50 cycles and B=10,000. Great care was taken during the building of the core to avoid filing the plates; these are held in position by means of dovetailed wedges fixed to the stator body. The total iron length of the stator, including ventilation ducts, is 2,780 mm.

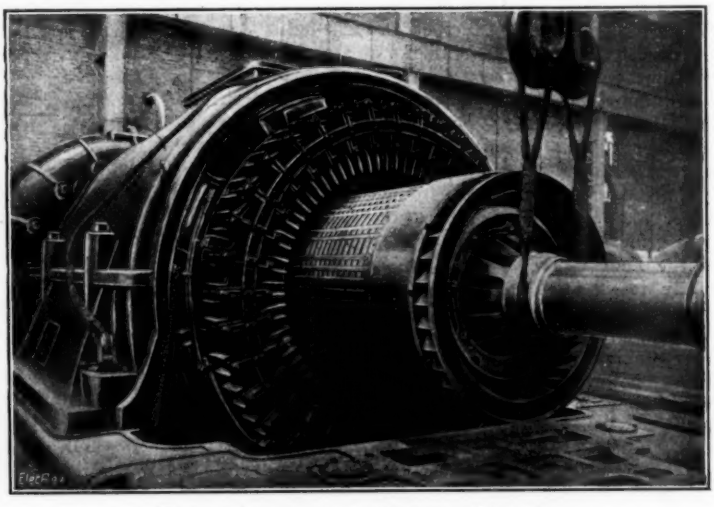


Fig. 2.—Alternator in Course of Erection.

The windings are in 144 slots, and the two conductors in one slot are soldered together at one end of the machine, thus forming a single conductor. To avoid circulating currents, the end-connections between slots corresponding to any one coil are crossed at the other end of the machine, so that the conductor at the bottom of one slot may be connected in series with that at the

top of the other. There are two circuits in parallel, giving 24 conductors in series per phase, which corresponds to a flux value of 138.5×10^6 Maxwells per pole at 6,000 V.

Fig. 5 shows the arrangement of the bars in the slot; they are built up of single strip conductors insulated from each other, and lie obliquely to the centre-line of the slot in such a way that they all have identical positions with respect to the slot-field; in this way the eddy-current losses are made very small. The mechanical rigidity of the bars is in no way affected by this sub-

the normal current. Of the 24 per cent., 10.2 per cent. is due to the leakage slots and 9.5 per cent. to the end connections.

One of the three machines was subjected to a violent short-circuit directly at the terminals, and was thus able to demonstrate its power of withstanding short circuits.

The leakage slots also play an important part in the ventilation of the stator, which is carried out thus: The fans situated at each end of the rotor, each of which delivers 18 m.³ per second, draw the air into the end-guards, where it penetrates between the end con-

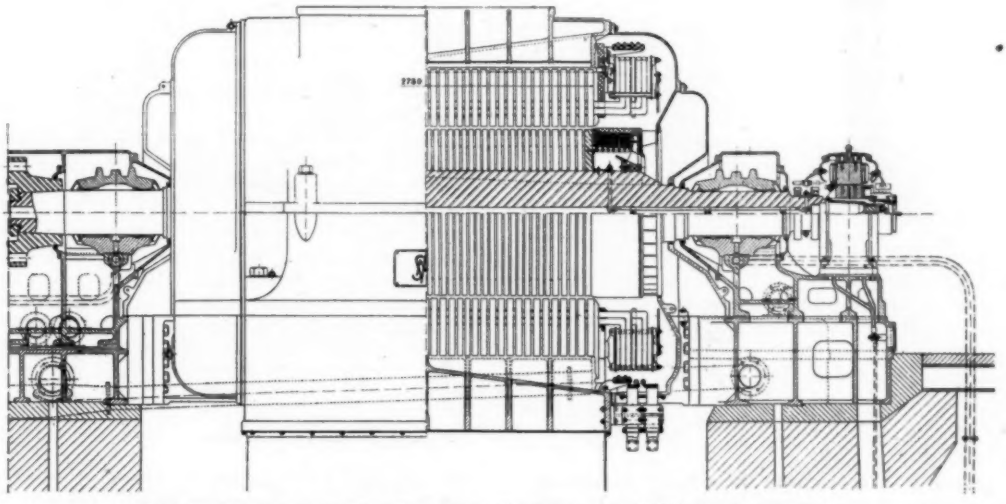


Fig. 3.—Longitudinal Part-Sectional Elevation of 40,000-kW Alternator.

division. The bars are built up and set in a mica wrapping, the thickness of which had to be increased owing to their great length; the reason is solely mechanical—the bars would be suitable for 12,000-volt machines. The end connections, of involute form, are riveted and soldered at the extremities of the bars, and insulated with several layers of mica tape; they are arranged in planes parallel to the stator laminations, thus ensuring absolute rigidity and solidity.

At the ends of the iron core and between the two ranges of the end connections are two annular plates of insulating material; these, having the same tooth form as the core-plates themselves, serve to hold the bars firmly in position. Blocks of insulating material are also used in the fixing of the end connections to maintain the spacing of the involute connectors relative to each other and relative to the stator end-plates. The whole of the winding, together with these blocks, is clamped by plates and bronze bolts; the clamping plates are themselves interconnected by a bronze ring giving very great strength. The machines were wound on site.

The most interesting detail of these machines is the leakage slots shown in fig. 5; these artificially increase the leakage of the stator, thus reducing the instantaneous short-circuit current to a very low value, and they also serve as a channel for the cooling air. The leakage slots are, for mechanical reasons, closed by a bridge.

The damping of the rotor being very efficient and the dampers' leakage very small, the value of the instantaneous short-circuit current depends essentially on the inductive drop due to stator leakage. There are two methods of increasing this drop. One can build a machine with a small flux-value, or, which amounts to the same thing, with a high armature reaction, in which case the large armature magnetomotive force produces sufficient leakage in the end connections; or one can proportion the alternator with a large flux-value and artificially increase the slot leakage. The second method has great advantages owing to the lessened stress on the end connections. In the machines here described, the inductive drop due to leakage is, with normal current, 24 per cent. of the normal pressure, corresponding to a symmetrical short-circuit current 4.17 times

nections, which are particularly well cooled, since a certain spacing is maintained between them, enabling the air to circulate freely around them. From the end-guards the air enters channels arranged in the frame, and is distributed to the stator ducts. A certain portion of this air cools the core in crossing the ducts and passes into the frame, which acts as an air chamber, but the greater portion penetrates between the teeth, then circulates axially in the leakage slots, and follows the reverse path in the next duct, from which it also

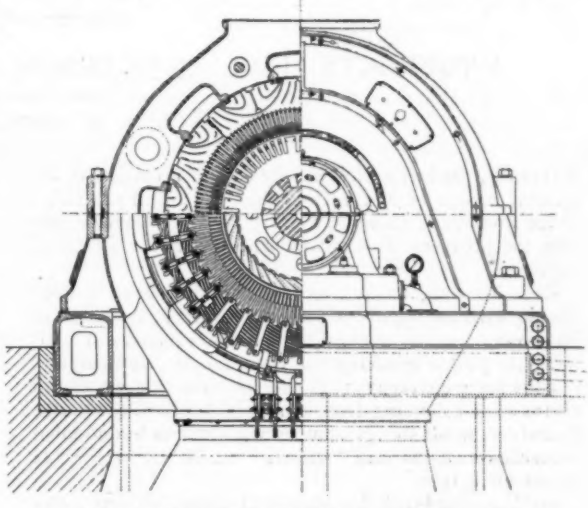


Fig. 4.—Transverse Part-Sectional Elevation.

passes to the frame. Experience has shown this system of ventilation to be very efficient. The axial air path is, in fact, very close to the conductors, and affords a very large surface for the transmission of heat.

This arrangement, due to the Société Alsacienne, has all the advantages of axial ventilation, but eliminates the production of high temperatures at the centre of the machine, usually associated with this system, since fresh air is distributed along the whole length of the lamina-

tions. The heating tests have given proof of the efficiency of this system of ventilation.

Several of the stator ducts are devoted to the extraction of the rotor air, so that the air circuits of the rotor and stator are completely separate.

Fig. 6 shows the general arrangement of the air-cooling system. To avoid the difficulties inherent to all filtering systems, the Union d'Electricité uses a closed air circuit, formed by the alternator and a water-cooled air-cooler. To recover the heat, which in an open-circuit system is carried off by the air, the condensate, after its ejection from the condenser, is used as the cooling medium; before returning to the boiler feed-water tank, this water circulates in the air-coolers, also recovering the heat lost in bearing friction; in this way a maximum efficiency is obtained. An important improvement due to the Société Alsacienne is one maintaining the quantity of cooling water greater than a given minimum whatever the load. A portion of the water is returned to the condensers immediately after leaving the air cooler. This arrangement was made to overcome the following difficulty:—The losses in turbo-alternators being only slightly variable with the load, whereas the amount of water condensed essentially depends upon it, there is a risk of over-heating the air on light loads if the quantity of condensate is alone used for cooling.

In very hot weather, the temperature of the condenser circulating water being very high, the temperature of the condensate may not be sufficiently low to ensure efficient cooling of the alternator air; in this case it is possible to circulate fresh water in a part of the cooler, and a special arrangement is provided enabling this part to be cleaned by water under pressure without shutting down the cooler. It is also possible, if necessary, to operate the cooler entirely on fresh water.

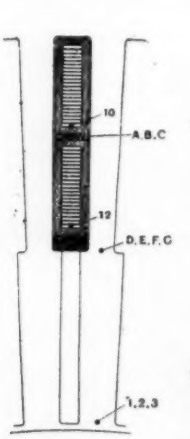


Fig. 5.—Stator Slot.

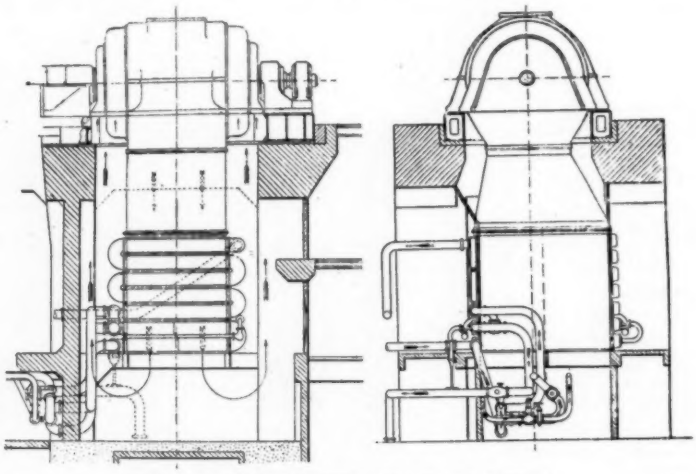


Fig. 6.—Closed-circuit Air-cooling System.

These different operating conditions are made possible by the arrangement of valves shown in the figure.

The machine is protected by the Merz-Price (balanced-current) system, and has therefore six terminals; the current transformers are mounted on the bars, and the star-point is connected directly to earth. The total weight of the alternator, including the exciter, is about 155 tons.

(To be concluded.)

PROSPECTS FOR ELECTRICAL ENGINEERS IN CANADA.—II.

By GEO. R. ARCHDEACON, A.M.I.E.E.

Having in the last article briefly drawn attention to the general aspect of emigration, and the social condition of the workers in Canada, we may now look particularly into the prospects in Canada as they affect electrical engineers.

Canada being located so near to the great United States, with its population of 110 millions, its immense resources, and its general aggressive commercial attitude, its people speaking the same tongue, and employing the same currency, it is only natural that we should derive some colouring from our neighbours to the south. Therefore, in all things commercial, Canada has adopted numerous methods and "stunts" which are strictly of American origin.

All our standards for electrical work, all our rules and regulations, are entirely derived from the standards of the American Institute of Electrical Engineers, whilst in things mechanical the same applies to the American Institution of Mechanical Engineers.

Therefore, as we look to the United States as our standard in our technique, so do we turn to them for a lead in the methods of merchandising our products.

Without the sales engineer, the factory would be without orders, the men would consequently be without work; hence the sales engineer and the sales department form one of the most important parts of the organisation. The Canadian method is to lay special stress on the sales department; no time or expense is considered wasted if results can be obtained. The money spent on advertising, following up, and entertaining is simply astounding.

The sales engineer is expected by his firm to "live well"; he must always (when on the firm's business) stay at the very best hotels, travel "first class" in Pullman and observation car; he is allowed considerable leeway in entertaining at the expense of the firm; and he generally comports himself as though he were a director of the company, but *he must produce results.*

To the man who has a sound technical training, a wide experience, and, in addition, possesses some claim to personal charm or personal magnetism, there are splendid opportunities in Canada on the sales force of our numerous large firms manufacturing electrical machinery and electrical supplies.

In this country nothing will sell itself, everything must be sold, and it is the realisation of this fundamental fact that has resulted in our intensified system of sales effort to overcome sales resistance. When this is fully appreciated, it will readily be understood why the sales engineer has achieved such importance in our

eyes. So as to permit him the fullest scope and application of his initiative, he is not hampered with petty restrictions; he is handed the proposition, given the price expected to be obtianed and the minimum price that will be considered. He is then left to his own resources to bring all his heavy artillery to bear, to choose his own time and his own methods; expense is not considered, but he must "bring home the goose" or an efficient alibi.

As in all other ranks, there are degrees of importance, varying from the man who sells small electrical supplies, to the man selling large turbo-alternators or an entire town light and power scheme, &c. In each case the remuneration is naturally in accordance with the importance of the position and the quality of service demanded. In the case of the man selling the small electrical supplies, his salary will run from $125 per month, with possibly a 5 per cent. commission, to as much as $200 per month and 5 per cent. commission.

On the other hand, the man negotiating the placing of the heavy power plant and equipment will doubtless earn from $200 per month salary, with a commission of perhaps 1/2 per cent. to perhaps 3 per cent., to as much as $500 per month and commission.

In many cases it is the rule to give a man a certain territory to work, and pay him strictly on commission, but pay him a monthly "drawing account" of anything from $150 to $300 per month, and balance his commissions with what he has drawn on account, every quarter.

When it is remembered that the firm is paying the board and lodging of its sales engineer for practically six months out of the year, it will be apparent what opportunities he has for saving out of his salary.

There is no disguising the fact that the sales department is really the side which seems to carry the most importance in our scheme of things. There are numerous companies paying their sales managers from $7,000 to $15,000 per annum.

Let us next consider the electrical engineer working in a manufacturing plant.

Such positions as production manager, or efficiency engineers, or chief designers, are, of course, at the "top of the tree," and such vacancies do not frequently occur. These men are paid from $3,000 to $6,000 per annum. Taking, however, the second line, or minor executives, such as draughtsmen, chief of test room, department managers, &c., they will be paid approximately $200 to $250 per month.

We next come to the power house staff, or operating engineers. These, as in England, are generally paid lower salaries and wages than pertains on the manufacturing side; still, their conditions are much better than for similar positions in England, *viz.*,

Switchboard attendants from	$80 to $125	per month.
Shift engineers from	....$125 to $250	,,
Station superintendents from	$200 to $300	,,
Mains superintendents from	$200 to $300	,,
Mains assistants from	... $100 to $200	,,

For the operating engineer there are many more opportunities here than in England, as we have a special condition to contend with.

On account of our cold winter, it is necessary in all hotels, factories, institutions, public buildings, &c., to have a considerable quantity of live steam available for the central heating system. The amount of steam so required is usually sufficient to supply from perhaps a 50-h.p. engine to as much as a 500-h.p. engine. In such cases it is usual to install one or more direct-driven d.c. generators, the engines running non-condensing during the winter, using their exhaust steam for the central heating system of the building.

There are, therefore, several thousands of such plants dotted all over the country; most of these employ a regular three shifts per day, and, as a result, find employment for thousands of electrical operating engineers. To the operating engineer who is earnestly looking for a job, and doesn't expect to find a manager's position immediately upon his arrival in this country, this is a most fruitful field of endeavour, as there are always so many vacancies arising on the staff of such plants. The salary is not to be lightly regarded either, the "chief" being paid from $200 to $250 per month, his first assistant from $150 to $200 per month, whilst the electricians and mechanics about the plant earn from 35c. to 60c. per hour, and work about a 50-hour week. This totalling from $17.50 to $30 per week, or, in sterling, at the normal rate of exchange of $4.80 to the pound, would amount to the not inconsiderable sum of £3 17s. 6d. to £6 5s. per week.

To the working journeyman electrician conditions are particularly favourable. There is plenty of work to be obtained, the building trade throughout the whole country is enjoying a brisk business, and is looking forward to excellent business this coming season.

Great undertakings and rapid electrical developments are on the "tapis" in every direction. For example:—

The Canadian Government railways are going to spend $10,000,000 in a wide electrification scheme.

The C.P.R. will naturally follow with further developments to keep pace with its mighty rival.

The city of Winnipeg has just placed an order for $250,000 for additional steam turbine plant.

The port of Vancouver has only just received a grant from the Government of $5,000,000 for extensions; to this will be added another $2,000,000 of local money towards the improvements. Quite a large portion of this will be spent in electrical equipment.

The port of Fort William is undertaking great extensions involving about $1,000,000.

The telephone service of the Province of Manitoba is being entirely changed over to the automatic system.

The telephone service of Ontario is also being changed over to the automatic system.

In Ontario the electrical development during 1923 will be remarkably extensive. The Hydro-Electric Power Commission is doing great things. On its Queenston-Chippawa plant it is developing 600,000 h.p.; already it has installed and has in operation three sets of 55,000 kW each. During 1923 it expects to complete another three sets of 55,000 kW each.

In the vicinity of Kingston, Ont., a further hydro development is progressing, which will render another 50,000 h.p. available for Kingston and the other towns in that district.

In the Province of Quebec many large electrical developments are under way; Drummondville is developing a new source of power to the extent of about 100,000 h.p.

On account of the electrical development in the district of Shawinigan Falls, there has already sprung up out of the "bush" a town of about 11,000 people, and located in that town of Shawinigan are the most remarkable and complete electro-chemical industries in the world.

The Canadian Car and Foundry Co. recently reported at its annual meeting that it had orders in hand for 1923 for the considerable amount of $28,000,000.

In view of these developments (which are only a few items that come to the author's mind without any special search for information), there is every reason to assume that all is well with the electrical industry; such being the case, there must be sound prospects for the immigrant electrical engineer.

Throughout the Province of Ontario there is a most complete network of light electric railways, and each town of over 15,000 people operates an electric tramway service, which usually penetrates considerable distances into the surrounding country.

Practically 50 per cent. of all the heavy electrical machinery needed for such undertakings already mentioned is "made in Canada," whilst with regard to the small electrical gear purchased by the electrical contractors, approximately 80 per cent. of this is "made in Canada."

Most of our large engineering works, rolling mills, boiler-making shops, shipbuilding plants, and foundries will compare favourably with the best in England.

It must therefore be readily admitted that there is a

place and opportunity for skilled electrical workers in Canada.

A recent report from the Electrical Contractors' Association states that a steady increase in business has been witnessed since the slump which followed the war, whilst business prospects for 1923 look particularly bright.

There is a splendid Workmen's Compensation Act, which is particularly favourable to the interests of the workman. This is administered by the Workmen's Compensation Boards, appointed by the Government. Each province possesses its own Board. This Board administers the funds, which are contributed to by each employer in the industry. Each employer pays into a central fund 1 per cent. of his annual pay roll.

In case of an accident arising out of a man's employment, the workman is paid 66⅔ per cent. of his wages during the period of his disability, receiving at the same time medical attention entirely free of charge. In the event of his death arising out of the accident, the widow (in the case of a married man) receives the same rate of compensation as was enjoyed by her late husband as long as she remains unmarried. Should she marry again, she receives a bonus of one year's compensation, then all further payments cease.

Particular attention is also paid to the training of men working on the extra-high-pressure mains and distribution systems, and on all classes of work in which there is any degree of hazardous risk. Every possible care is taken of the man; in fact, the Hydro-Electric Commission of Ontario makes a special study of the subject of safety devices, and has engaged a well-known expert, who possesses a reputation throughout the United States for this class of work. This gentleman is Mr. Willis McLoughlin. He is the head of this department of safety, and he lays down the rules regulating the conditions of labour (with regard to safety) both in the generating stations and on the distribution system. He holds from time to time classes of instruction for all employés. Mr. McLoughlin would be pleased to supply any information desired for the organising of any such system; any person interested may write to him, c/o Hydro-Electric Power Commission, University Avenue, Toronto, Ont.

Wages paid to the journeyman electrician are as follows:—

Foremen	90 cents to $1.10 per hour.
Electricians	80 ,, ,,
Helpers, first class ...	60 ,, ,,
Helpers, second class ...	35 ,, ,,

The regular hours are eight per day, with five hours on Saturday, making a 45-hour week.

The ordinary skilled electrician, therefore, earns a total of $36 per week, or £7 10s. per week.

This high wage of course means nothing, unless we take into account the cost of living.

Herewith is a list of the most important items affecting the cost of living:—

Rent of 5-roomed house (in large cities)	$30 to $40 per month
Rent of 5-roomed house (small towns)	$20 to $30 per month
Beef	18c. to 33c. per lb.
Butter (varying with quality & season)	35c. to 45c. per lb.
Sugar	9c. to 10c. per lb.
Eggs (varying with quality & season)	25c. to 50c. per doz.
Milk	6c. to 7c. per pint
Tea	35c. to 50c. per lb.
Boots	$5 to $8 per pair
Suits	$25 to $40
Overcoats	$25 to $50
Shirts	$1.50 to $3.00
Socks	$1.00 to $2.00
Electric light, per kWh	2c. to 10c.
Gas, per 1,000 cu. ft.	$1.50 to $2.00
Street car fares	5c. to 7c.
Hotels (including all meals)	$5 per day
Railway fares (first class)	3c. per mile.

There are many excellent opportunities for any skilled electrician who possesses about $2,000 to open up a small business for himself. The country is so rapidly developing that there are numerous small towns in which he might locate and rapidly attract to himself a steady *clientèle* of a most profitable nature. To any such person who has familiarised himself with the operation of a motor-car there are splendid openings.

As before mentioned, there are about 475,000 automobiles throughout the Dominion; about 80 per cent. of these possess electric lighting and self-starting systems. Each of these requires a somewhat complicated system of wiring for the operation of the charging and discharging of the battery in connection with the starting system and the lighting and ignition system.

There are many well-equipped garages for the mechanical repairs, but there is a distinct shortage of really good electricians to effect efficient repairs to the electrical system.

Speaking from personal experience, the writer has an agent in a town out West of a population of only 7,000. This man sells annually about 350 storage batteries, on which he makes a gross profit of about $12 per battery; in addition, he obtains for winter storage about 1,000 batteries, for which his average charge is about $8 per battery; his gross profit on this should be not less than 33⅓ per cent. This man started only six years ago with a capital of $1,000; to-day his estimated worth is $25,000.

In another Western town there is another agent, who recently showed the writer more than 50 small starter motor armatures he had to re-wind.

In another similar town is a small man whose average takings amount to approximately $1,500 per month. This business is operated by two men and the proprietor.

The total cost for equipping a battery service station and automobile electrical repair shop will not exceed $700, and, with the outlay of another $300, a modest stock of batteries and parts may be laid down. Presuming a man already possesses a decent kit of tools, the cost of his equipment may be considerably reduced.

By making a plunge such as this course suggests, a man ceases to be a mere "wage earner," and automatically becomes an independent proprietor; to some extent he may be considered to have entered the capitalist class. Let him carefully study the scientific methods of merchandising, make a point of rendering to his clients an honest and reliable service; let him do a little more than he is paid to do; let his work just be a little better than the other fellow's"; and his name will soon be noised abroad, and his clients will soon beat a pathway to his door.

In concluding this brief article on a subject which could easily fill a volume, the author wishes to quote from the observations of Field-Marshal Sir William Robertson, extracted from his most fascinating book, "From Private to Field-Marshal":—

"Although I saw but little of Canada, what I did see came to me as a great surprise. The large towns, with their fine thoroughfares and magnificent buildings, have an air of business grandeur of which most people in England have no conception, and the rate and scale at which the Dominion has been developed must be seen to be correctly appreciated."

Electric Propulsion of Ships.—At the annual meeting of the Institution of Engineers and Shipbuilders in Scotland, of which Mr. J. Howden Hume is the new president, Mr. W. J. Belsey read a paper on "Electric Transmission of Power for Propelling Machinery," in which he dealt with the turbo-electric and Diesel-electric types. He stated that the merchant ship *San Benito* had been in service for 14 months, and had travelled upwards of 76,000 miles. During that time nothing had been spent on the upkeep of the propelling machinery, and she had not lost a single hour's sailing due to any defect in the propelling machinery. He claimed that electrical transmission of power for propelling purposes, for 3,000 h.p. upwards per propeller, was a little more economical than single-reduction gearing, was decidedly more economical than double-reduction gearing, and also was more economical than the old-fashioned reciprocating machinery. Another point was that the electrical drive was noiseless in operation, which was a feature of great importance from the point of view of popularity with passengers. For the Diesel-electric type he also claimed that economical running could be obtained over a wide range of power.

NEW ELECTRIC CARS.

The Bradford Corporation "One-Man" Railless Vehicles.

Railless vehicles are operated in Bradford along routes which have a very light traffic, and in order to reduce costs to a minimum, vehicles have been introduced of the "one man" type, in which the driver, in addition to operating the vehicle, collects the fares of passengers and issues the necessary tickets for their journey.

In order to do this, the vehicle has been designed with a front entrance immediately at the rear of the near-side front wheel, fig. 1, which is closed by two doors, each operated by the driver. When loading passengers the forward half door is opened and passengers have, therefore, to enter in single file and pass the cash desk by the driver. When unloading, both doors are opened, allowing a wide egress, enabling the passengers to leave the car in as short a time as possible. Before starting the vehicle, the driver closes the doors by means of levers, and when closed the doors are firmly held in position by a bolt which is operated by the driver by means of a foot pedal. The bottom step is connected to the door, and is lifted at the same time the door is closed and *vice versa*.

The seats are arranged transversely on each side, with a commodious centre aisle, and provide seating for 30 passengers. The interior is divided into two compartments; the rear, seating 13 passengers, is the smoking compartment, and the forward portion accommodates non-smoking passengers.

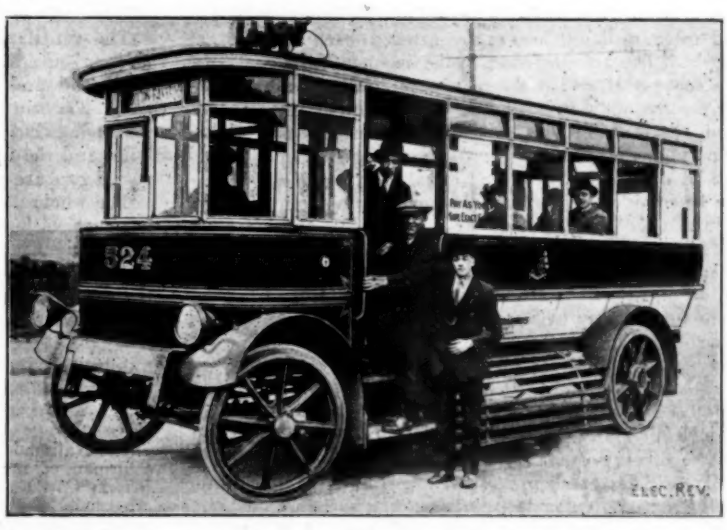


Fig. 1.—The Bradford "One-Man" Trolley 'Bus.

The vehicle is mounted upon a chassis having a wheel base of 14 ft., the rubber-tire wheels being 40 in. in diameter. The overall length of the vehicle is 21 ft. 9 in. and the extreme width 7 ft. 6 in., and it is fitted with side lifeguards. The chassis frames are of steel sections, fig. 2, with substantial crossovers.

The motive power is furnished by one Dick, Kerr 31 B ventilated-type tramway traction motor, which is uniform with those at present used on the Corporation's tramcars. This type of motor has been adopted on account of its robustness and non-liability to failure, in addition to its capacity for withstanding heavy overloads.

From experience on the two top-deck vehicles already constructed, which have been in service for some time,

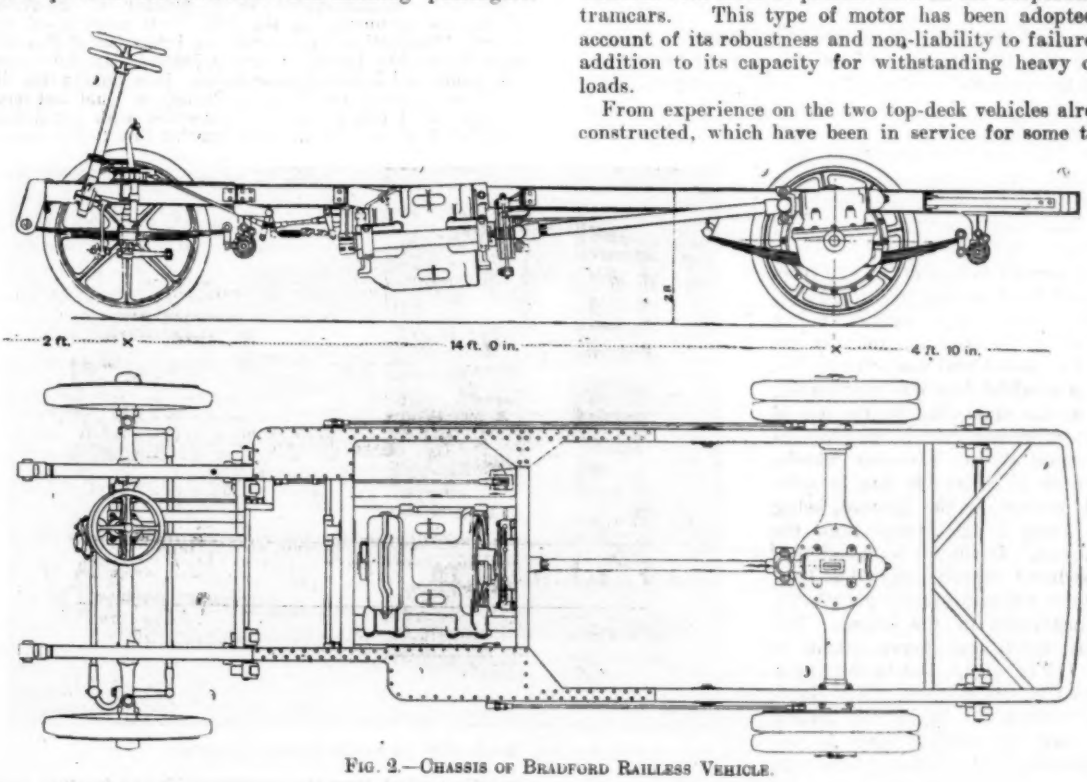


Fig. 2.—Chassis of Bradford Railless Vehicle.

A rear emergency exit is provided. The driver's cab is very commodious, extending to the full width of the vehicle, and can be used for the carriage of passengers' luggage.

it is found that a single motor gives practically the same result (so far as efficiency, measured in kWh per car mile, is concerned) as that of series-parallel control, with the advantage that a very simple type of controller is

required for use with the single motor, as compared with that for series-parallel control. The usual type of series-parallel control as used on tramcars proved very unsatisfactory when installed on railless vehicles, due to the shaking loose of the controller components. Controllers constructed for operation on railless vehicles should be specially designed to cope with the vibration occasioned when the vehicle is running over rough roads.

Transmission is through a hollow propeller shaft coupled to the motor with ball-bearing universals, and with a similar type of universal to the back axle, the latter being of the Kirkstall solid-forged type with a worm and worm-wheel drive.

A transmission brake is provided on the motor shaft, and internal drum brakes are fitted to each of the rear wheels. The transmission brake is operated by means of a foot pedal, whilst the rear wheel brakes are operated by means of a hand wheel and hollow shaft mounted upon the steering column. This form has the great advantage of giving a very large range of operation, and by its means the Ferodo brake lining of the shoes can be completely worn out without having to make any adjustments to the brake gear.

The springing of the vehicle has received earnest consideration, and is based upon the results of tests carried out on other railless vehicles, the springing upon the new "one man" cars being extremely satisfactory. Shock absorbers, which are fitted to both front and rear springs, have contributed considerably to this end.

The trolley bases are of the well-known flat type, which have been designed and used at Bradford on railless vehicles for many years. In place of trolley wheels, skid shoes are being used.

Six vehicles are being constructed, and the first four are now in daily service, giving every satisfaction.

We are indebted to Mr. R. H. Wilkinson, A.M.I.E.E., M.Inst.T., general manager of the Bradford Corporation Tramways, for the details outlined above, and to the *Tramway and Railway World* from which fig. 2 was reproduced.

A New Cardiff Double-deck Tramcar.

The double-deck top-covered tramcar illustrated in fig. 3 has recently been supplied to the Cardiff Corporation Tramways, and is specially designed to pass under the low bridges existing on various routes. The difficulty has not hitherto been surmounted and, consequently, this is the first double-deck top-covered car that has been run on the Cardiff system.

The overall height of the car from the rail level to the trolley base is 14 ft. 9 in. This unusually low dimension has been attained by the use of a special steel underframe (the design of which has been registered), and at the same time by the use of 25-in. diameter wheels in place of the usual 32-in. diameter wheels. The floor of the car is thus brought much nearer to the ground, being only about 2 in. higher than the platforms. It should be noted that the reduced overall height has been attained without unduly restricting the headroom in the saloon. The height inside the lower saloon is 5 ft. 11½ in. clear, and in the upper saloon 5 ft. 10 in. clear. The clearance between the top of the trolley base and the trolley wires is approximately 1½ inches when the car is passing under the lowest bridge, giving ample clearance.

The car is mounted on a Brush four-wheel truck embodying the Peckham patent pendulum gear, the special feature of which is the flexible suspension of the axle boxes that gives smoother running on a straight road and enables the car to negotiate curves very readily.

The construction of the car body itself is in accordance with the latest practice of the Brush Electrical Engineering Co., Ltd., for tramcars, the main framing being of teak reinforced by steel plates and sections. The seating capacity of the car is for 64 passengers, 24 in the lower saloon and 40 on the top deck. The interior of the lower saloon is finished in oak, and the ceiling is of millboard finished in white enamel. The upper saloon side walls and ceiling are formed of narrow match-boarding, alternate boards being stained a dark colour and varnished.

The ventilators of the lower saloon are operated by mechanism and arranged so that fresh air enters at the front end and the foul air is extracted from the rear end. The windows of the upper deck are arranged to be lowered. Each platform is enclosed in a glazed vestibule, and the upper saloon is totally enclosed so that all passengers are protected from the weather.

The whole design is of very pleasing appearance, and has met with the approbation of the Cardiff tramway authorities and the public.

A low-type top-covered car has also been supplied to the Salford Corporation to meet the same conditions as those outlined above, and has been so successful in operation that a further contract has been placed for a number of similar vehicles.

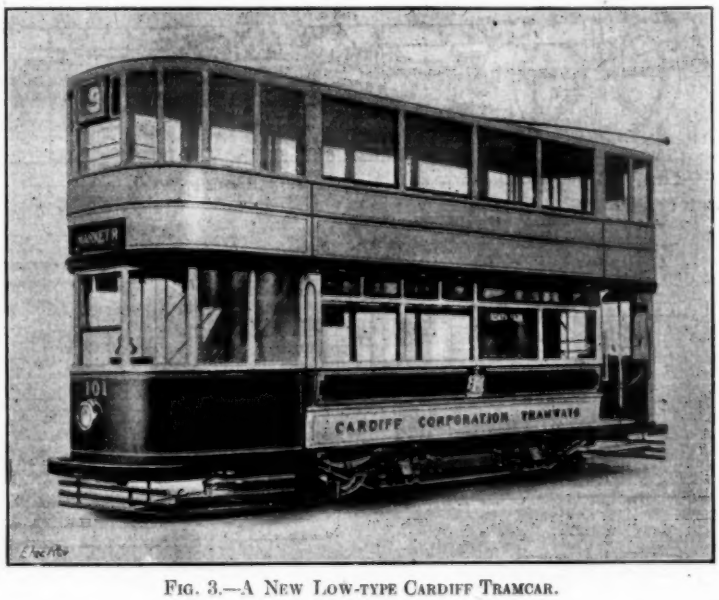


Fig. 3.—A New Low-type Cardiff Tramcar.

The National Illumination Committee.—The report of the chairman of the National Illumination Committee of Great Britain (Mr. K. Edgcumbe) for the year 1922, states that the provisional Definitions of Photometric Terms and Units, issued in February last, have been officially adopted by the three constituent societies. These form the basis of a set of Photometric Conditions shortly to be issued by the British Engineering Standards Association as part of a comprehensive set of electrical engineering terms. A preliminary list of symbols has also been prepared by the Nomenclature Sub-Committee, and, after submission to the British Committee, it has been communicated to a number of interested societies for comment. At the 1921 Paris meeting of the National Illumination Commission, an International Committee on Automobile Headlights was appointed, Mr. Edgcumbe being nominated British representative. It is thought that the way in which the British National Committee could best serve the interests of this country in connection with automobile headlights is to appoint a sub-committee to consider recommendations which have already been published in other countries, with a view to arriving at international agreement.

The B.E.S.A. has been asked to form a sectional committee on illumination to deal solely with standardisation or similar questions referred to it by the British National Committee.

THE WIRELESS MONOPOLY.

By W. C. JEARY.

With reference to the articles which appeared recently in a daily paper, I should like to point out some very misleading statements which have undoubtedly been the cause of the depression in the wireless trade during the past two weeks.

It has been stated that "wireless sets being sold for £2 to £25 can be made by an amateur for a few shillings." It is true that an amateur may make a crystal set that is good enough for his own purpose for a few shillings—but the writer omitted to add that a pair of head 'phones must be purchased at an average price of 30s. per pair; also, a set selling at £25, would obviously be a valve set, with at least two valves, these valves costing 30s., 'phones 30s., accumulator 25s., high-tension battery 15s. These accessories, without allowing anything for the cost of the actual set, would work out to the buyer at a few pounds (not shillings).

Further, a member of the staff of the daily paper in question purchased (apparently in the open market) a crystal set for 1s. 4d., and his complete installation, without head 'phones, was bought at a total cost of 3s. 4d., and gave excellent results. The trade has been anxiously searching the market for this wonderful set, but so far without result.

The real grievance to the trade, and the public, is not the price charged for wireless sets (which in most cases shows a very poor profit to the manufacturers) or the small royalties charged for the upkeep of the broadcasting stations, but the fact that the B.B.C. is run by electrical companies instead of experienced people connected with the entertainment profession, who, knowing the public taste, would be able to give entertainments to suit, and who have the best artistes under contract to them.

Impartial critics cannot truthfully say that the B.B.C. programmes are universally bad, or indifferent, and one must take into consideration that an entertainment is broadcast every night, and therefore an occasional "off night" is only to be expected.

If a music-hall had to provide fresh artistes every night, instead of the same artistes appearing each evening for at least a week, as at present, the music-halls would be open to the same criticism as the B.B.C., and I would suggest that the B.B.C. restrict themselves to giving two FIRST-CLASS entertainments per week, and allow the amateurs to broadcast the remaining five days. If anything, our entertainments are much more varied than the American programmes that one sees from time to time, and monopoly seems to exist there just the same, but instead of one company broadcasting, there are a favoured few who take turns.

There is one important point which is generally overlooked—if all restrictions are removed, the market will be flooded with foreign sets and parts, and a very promising business which is giving work to thousands will be nipped in the bud. One daily paper is very anxious to broadcast without charge, but it does not give any intimation whether it would broadcast from Glasgow, Cardiff, Manchester, Birmingham, &c., or only from London. If the latter, then crystal sets, which are the only sets that can be made for a few shillings, would be useless outside the London area. If it is the intention to broadcast from all chief centres (and no charge to be made for royalties and licences), who is to pay artistes, orchestras, &c., and for the supply and upkeep of plant?

It has been stated in the Press that the cost of maintaining each station is £20,000 per annum. It is difficult to believe that disinterested parties are willing to spend even half this amount without any return, and I am rather afraid that to obtain adequate return for the outlay, good use would be made of broadcasting for advertising, and the programmes we should have would be something after the following style:—

DAILY PROGRAMME.

Breakfast Time.—Daily Horror calling ½ S-O.

We give 24 beautiful pages for 1d. (one penny). We insure you against any kind of death, and £1,000 (one thousand pounds) will be paid to the next-of-kin, or any of your old friends.

Are you having "Hockeimer's" oats for breakfast?—only 6d. (sixpence) a packet, can be eaten hot or cold. Must close down now; illustrated caricatures next turn. Do not forget insurance scheme.

½ S-O *Daily Horror* closing down.

Lunch Time.—Daily Horror calling ½ S-O.

Have you let your husband go to business without signing our insurance coupon? If so, wire or 'phone him now; he may not live through the day.

Are you enjoying Butcher's famous ox tongue? Supplied in either glass moulds or tins; can be obtained at all grocers at prices to suit all pockets.

Stand by for one minute, when the *Daily Horror* Gramophone Orchestra will give a selection—Fox Trot: "Any Time is Free Insurance Time," followed by a lecture from Professor Patriot: "How the Germans have Improved their Rate of Exchange since the B.B.C. was Abolished."

½ S-O *Daily Horror* closing down until evening performance.

Evening Performance.

½ S-O *Daily Horror* calling.

We have paid out £5,000 (five thousand pounds) for insurance in one week; do not go to bed before signing our insurance coupon, you might be murdered or suffocated in your sleep. DO IT NOW. Also, send for new booklet, "Wireless the Free," and learn how to make a wireless outfit with a few pins, reel of cotton, and odds and ends from the garden for the total cost of three-halfpence.

Stand by for lecture from Herr Wilmheim Fitzfree: "The Advantage of Buying, Selling, and Using German-made Sets," which will be followed by the *Daily Horror* Orchestra—ONE STEP: "Keep Oscillating all the Time," after which ½ S-O *Daily Horror* is closing down to allow 16 other newspapers to broadcast—Goodnight!

The Whitworth Society.—A circular letter, copy of the rules, and subscription form have been posted to every Whitworth scholar, exhibitioner, and prizeman whose present address is known. The preliminary dinner is to take place on September 11th next, at the Shipping, Engineering, and Machinery Exhibition, Olympia, London, where the members will be received by the chairman of the Whitworth Society, Dr. F. S. Hele-Shaw, F.R.S., who is also chairman of the Committee of Experts of the Exhibition. Anyone eligible for membership, who has not already received the above information, is requested to communicate at once with the hon. secretary, Whitworth Society, Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1.

The New C.S. "Faraday."—The twin-screw cable steamer *Faraday*, built by Palmer's Shipbuilding and Iron Co., Ltd., at the Jarrow shipyard to the order of Messrs. Siemens Brothers & Co., Ltd., of which some particulars have already appeared in our pages, was taken to sea on April 6th and 7th for her trials, which we understand were quite successful, a speed of about 13 knots being attained; the machinery worked smoothly throughout.

Decimal Coinage.—The Decimal Association has reprinted in pamphlet form correspondence with the Chancellor of the Exchequer on the Majority Report of the Royal Commission on Decimal Coinage, to show cause why a further Committee should be appointed by the Government to examine and report upon the proposal to increase the token values of the copper coins (only) by 20 per cent., to give ten pence to a shilling instead of twelve.

PARLIAMENTARY NOTES.

[By Our Special Parliamentary Reporter.]

Wireless Stations.—On April 12th Sir Harry Brittain asked the Postmaster-General whether his attention had been called to the statements of the Marconi Co. as to the delay on the part of the Post Office in granting to the company licences for the erection of wireless stations, and what was the cause of such delay.

Sir W. Joynson-Hicks said his hon. friend's statements were not correct. Immediately on his appointment as Postmaster-General he reviewed the whole matter in consultation with the Chairman of the Imperial Communications Committee and addressed a letter to the Marconi Co. on March 26th, asking it to favour him with any proposals which it desired to make in connection with the recent decision of the Cabinet permitting private enterprise to take its full share of imperial and international wireless work. On April 3rd a reply was received to this letter, in which the Marconi Co. pointed out that its proposals must depend on a closer knowledge of the Government's policy than it at present possessed, and it asked that he should meet its representatives in conference. This he proposed to do in order that they might put before him any schemes or proposals for any licence which they desired to obtain.

Replying to a further question, Sir W. Joynson-Hicks said he was aware that there was some difficulty in receiving messages at the Devizes wireless station from the Western Atlantic owing to interference. To meet these difficulties a new receiving station was being provided in the neighbourhood of Weston-super-Mare, and on its completion he anticipated that these difficulties would disappear. At the same time high-speed apparatus was being installed.

The Budget.—The Budget statement was made by Mr. Baldwin, the Chancellor of the Exchequer, on April 16th. The main features are:—Reduction in the standard rate of income tax of 6d., making the rate 4s. 6d. in the £; Corporation tax to be reduced from 1s. to 6d. in respect of profits received after June 30th; beer duty to be reduced by 1d. per pint; telephone rents to be reduced 10s. a year; local telephone calls to be reduced from 3d. to 2d.; trunk calls to be reduced. The telephone reductions are to date from July 1st. The postage rates are also to be modified as follows as from May 14th:—Inland letters: The initial rate for inland letters is to be 1½d. for 2 oz., instead of 1 oz., with ½d. for every additional 2 oz., instead of 1 oz. Letters to British Possessions, Egypt, the United States, and Tangier: The initial rate of 1½d. for the first oz. remains, but every additional oz. will be charged for at the rate of 1d. instead of 1½d. Foreign letters: Not exceeding 1 oz. 2½d. (instead of 3d.), the charge per additional oz. remaining at 1½d. Inland printed papers: Not exceeding 2 oz., ½d. with ½d. for every additional oz. up to 2 lb. (The existing rates are 1 oz. ½d., 2 oz. 1d., every additional oz., up to 2 lb., ½d.) Inland parcels: Not exceeding 2 lb., 6d. (9d.); not exceeding 5 lb., 9d. (1s.); not exceeding 8 lb., 1s. (1s. 3d.); and not exceeding 11 lb. 1s. 3d. (1s. 6d.).

Electrical Energy from the Jordan.—On April 16th, Mr. Becker asked the Under Secretary of State for the Colonies, if he would state what progress had been made with the harnessing of water power for producing electrical energy from the River Jordan; and if contracts for plant and equipment were being placed in this country.

Mr. Ormesby Gore replied that the actual work of equipping the station for the Jordan hydro-electric scheme could not be undertaken until the formation of the company, which was to hold the concession, had been completed; but he was informed that, concurrently with the legal procedure which this involved, good progress was being made with the preparation of plans and specifications, which would enable tenders for plant and equipment to be called for.

LEGAL.

London's Electricity Supply.

The King *v.* the Electricity Commissioners, *nisi* for *certiorari* of scheme (*ex parte* London Electricity Joint Committee and Others.)

On April 13th this case came before a King's Bench Divisional Court consisting of the Lord Chief Justice and Justices Avory and Roche, the Crown appearing to show cause against two rules *nisi* which had been obtained against the Electricity Commissioners, one for a writ of prohibition and the other for a writ of *certiorari* with regard to the scheme of effecting an improvement of the existing organisation for the supply of electricity in the London and Home Counties Electricity District.

Mr. Tyldesley Jones, K.C., Mr. W. S. Kennedy, Mr. R. Harker, and Mr. A. Taylor appeared for the applicants for the rules; and the Attorney-General (Sir Douglas Hogg, K.C.), Mr. Macmorran, K.C., and Mr. W. Bowstead represented the Crown; Mr. Craig Henderson representing the London County Council.

The Attorney-General said that the rules were granted on the following grounds.—

(*a*) That the provisions of the said scheme, whereby it is made compulsory upon the Joint Electricity Authority at their first meeting to appoint and keep appointed two committees of the Joint Electricity Authority, are *ultra vires* the Electricity Commissioners and contrary to the Electricity (Supply) Acts, 1919 and 1922.

(*b*) That the provisions of the said scheme, whereby it is rendered compulsory upon the Joint Electricity Authority to delegate to the aforesaid two committees the powers and duties of the Joint Electricity Authority mentioned in the third annex to the said scheme, are *ultra vires* the Electricity Commissioners and contrary to the provisions of the Electricity (Supply) Acts, 1919 and 1922.

Sir Douglas Hogg contended (1) that the applicants for the rule had wholly misconceived the position of the Electricity Commissioners, and that *certiorari* and prohibition would not lie; and (2) upon the merits that the Acts of Parliament gave ample power to the Electricity Commissioners to do all that they were alleged to be proposing to do under the affidavits and the rule.

Mr. Tyldesley Jones, in support of the rule, replied to the arguments of the Attorney-General. The Commissioners, he said, had endeavoured to meet certain objections put forward by his clients in a way which, if valid, would to a large extent meet the point, but the applicants said that these matters would not be effected in the way the Commissioners proposed.

The Lord Chief Justice: Am I right in thinking that the real object of these proceedings is to ascertain whether this scheme, if carried through, would be, as you say, water-tight?

Mr. Tyldesley Jones replied in the affirmative. He said that the companies had the right to ask the Court to issue the writs if the Commissioners were proposing a scheme which was clearly contrary to the Act.

The Lord Chief Justice, in giving judgment discharging the rules, said the real crux of what was complained of—if indeed it was complained of—was that under the draft scheme these duplicated committees were appointed and powers were compulsorily delegated to them. Under the Statute, when the scheme had gone very much further than the stage it had now reached, it still remained something quite in the air. Not to mention other opportunities for reflection or consideration, the Minister of Transport might make modifications, and either House of Parliament might refrain from passing the resolution which was contemplated. It was not until all these difficulties were surmounted that the Order really became operative. It was at one time a little difficult to perceive whether those who obtained these rules were really sincere in their desire to quash or prohibit the scheme. There were moments when he wondered whether Mr. Tyldesley Jones felt that the scheme was too mischievous to be tolerated or too good to be true. He was quite satisfied that counsel's view was the latter, and that he really came to Court, not to quash or prohibit that against which his observations were directed, but to make quite sure by anticipation that when this, which he so much desired, was carried out nobody would hereafter be able with effect to assail it. That seemed to him to be a somewhat curious use of the machinery of *certiorari* and prohibition. He did not think it necessary to consider whether in certain circumstances a writ of *certiori* or prohibition might not lie to the Electricity Commissioners under the Act of 1919. The main argument was that this was not a case in which the writ was issued because a provisional Order had no effect until it was converted into law. They were here dealing with an intricate and embryonic Order which had still to run the gauntlet of the Minister of Transport and the Houses of Parliament. It was not until those stages had been passed that the scheme would become operative. The whole substance of Mr. Tyldesley Jones's argument would have disappeared if, instead of using the word "shall" the Commissioners had used the word "may." But the Commissioners invited him to make suggestions. Whether he would do so hereafter he would not stop to conjecture, but it was still open to the authorities mentioned to adopt that or any other modification. Therefore, without expressing any opinion, either upon the general question whether in a proper case a writ of *certiorari* or prohibition might be directed to the Commissioners, and without saying whether that which was done or contemplated was precisely within the four corners of the Statute, he was satisfied that at this stage, at any rate, this was not a case in which there should be a prohibition or *certiorari*. The rule would therefore be discharged.

The other judges concurred and the rule was discharged accordingly, with costs.

The British Thomson-Houston Litigation.

Mr. Justice Russell, in the Chancery Division, on Friday, heard a motion by the British Thomson-Houston Co., Ltd., against the Premier Electrical Stores, for an injunction restraining an infringement of one of its incandescent lamp patents.

Mr. Trevor Watson, for the plaintiffs, said it had been agreed that the motion should be treated as the trial of the action and the defendants would consent to judgment.

Mr. Tanner, for the defendants, said that that was so and added that the defendants were innocent infringers.

Mr. Justice Russell, in the Chancery Division, on Friday, had before him a motion by the British Thomson-Houston Co., Ltd., against A. Horn and J. Kremenezky for an injunction restraining an alleged infringement of its incandescent electric lamp patents.

Mr. Courtney Terrell (for M. Kremenezky) said that an injunction had been granted against Horn, who was selling agent in this country, and he asked for an adjournment to communicate with his client, who was in Vienna.

His Lordship granted an adjournment for 14 days.

W. F. Stanley & Co., Ltd., v. Parr.

In the Mayor's and City of London Court, on Monday, before Judge Shewell Cooper, a claim was made by W. F. Stanley and Co., Ltd., scientific instrument manufacturers, 286, High Holborn, against Mr. C. E. Parr, electrical engineer, 81, Bishopsgate, for £63 10s., for breach of contract for work done in the design and manufacture of an electrical thermometer to the order of the defendant. The plaintiffs' case was that in October, 1922, they were employed to make an electrical thermometer from designs left with them by Mr. Coltman. Mr. Coltman told them that the thermometer was his invention, but that he had sold the patent rights to Capt. Parr. The principle of the invention, said counsel, was that a vertical thermometer was to be placed in the hold of a vessel with the cargo and that was connected, by electrical contact, to a disk kept in the captain's room, so that supposing the captain had to deal with a cargo of fruit, and his instructions were that the temperature of the hold should not be more than 70 deg. or not below 60 deg., the captain set the disks accordingly, and the moment the temperature limits were exceeded a warning bell was rung. Plaintiffs, after a good deal of experimental work, they having, it was alleged, been given a free hand not to work to the drawings, succeeded in December in making a satisfactory model. In January, after having a demonstration, Capt. Parr asked to be supplied with plaintiffs' account. This was sent for the amount now sued for. Capt. Parr replied that such an account surprised him as it was out of all proportion to the results, and that he had been told the account would not amount to more than £10. He asked the plaintiffs not to trouble further in the matter. Evidence was given by the plaintiffs to show that their charges for experimental work in making the machine in question were fair and reasonable. For the defence it was said that no satisfactory model had ever been made by the plaintiffs, and that the prices charged were excessive and unreasonable.

Judge Shewell Cooper, in giving judgment, said he was of opinion that the work done by the plaintiffs was in accordance with Mr. Coltman's instructions, and must be paid for by the defendant. But how much the plaintiffs ought to have was not an easy matter. Using the best judgment he could, in a somewhat difficult matter, there being a great deal of delicate work and work involving great skill, he considered a fair figure was £52 10s., for which he would give judgment for the plaintiffs, with costs. Of course, the defendant would be entitled to the design and the instrument, which he (the judge), hoped the defendant would be able to turn to good use.

Electrical Apparatus Co., Ltd., v. Manufacturers' Export Association.

A dispute over the sale of a quantity of electric insulating porcelains came before a King's Bench Divisional Court (Justices Lush and Salter) on Tuesday, April 17th, when their Lordships were asked to give further consideration to the case of the Electrical Apparatus Co., Ltd., *v.* the Manufacturers' Export Association.

The matter first came before Judge Parry at the Lambeth County Court on December 20th, the plaintiffs claiming the return of £49 17s. 6d. paid to the defendants in respect of goods which they alleged had not been delivered. Defendants maintained that the goods had been delivered, and that under the circumstances they were at the purchasers' risk.

The judge decided in the plaintiffs' favour, and against his decision the defendants appealed on the ground that he was wrong in law in finding that the property did not pass.

Mr. Reginald White, who appeared for the appellants, said that at the hearing there was no dispute as to the facts. No evidence was called, and the matter turned on the documents.

The dispute arose over the sale by the appellants to the respondents of some electric insulating porcelains. The Manufacturers' Export Association, which was the trading name of Mr. Cecil, the defendant, had a contract for the supply of these goods with a firm in Czecho-Slovakia. The latter by that contract were to supply the goods at a fixed price. There was an alteration in the rate of exchange, and the Czecho-Slovakian firm said they could not supply the goods without ruining themselves. Under the circumstances they maintained that they were entitled to cancel the contract. Mr. Cecil, however, had given contracts in England for the supply of the goods at fixed prices, and he said that if they were going to cancel the contract, he would not pay them for goods then in transit and forming the basis of the present dispute. He did not, in fact, pay specifically for those goods, which had been handed over to the carriers for delivery to Mr. Cecil's English customers. While they were on the way from Czecho-Slovakia to the English customers the Czecho-Slovakian firm purported to stop the goods in transit.

Defendants' contention in the Court below was that the firm had no right to stop the goods, and the loss must fall upon the plaintiffs, since by the conditions of sale the property had passed.

After hearing legal arguments, their Lordships said they were both of the opinion that the dispute had not been sufficiently thrashed out in the Court below.

Mr. Justice Lush said there were two questions which would have been gone into if evidence had been called. The first fact which ought to be considered on evidence was: What was the contract between the parties? Was it the conditions of sale only or was it those conditions plus certain letters passing between the parties? That was an important question, because he did not think the conditions of sale were in all respects consistent with the letters in question.

The second question was: What did the parties both contemplate by the words "shipper's receipt" as used in the conditions of sale? Light might be thrown upon that point by evidence as to the previous course of business between the parties.

The case was sent back, the judge to take and consider evidence on those two questions, the costs of the appeal to be costs in the case.

The Radium Industry.—In a paper read before the American Chemical and Electrochemical Societies in February, and reprinted in *Science*, it is stated that radium has been found in Bohemia, Portugal, Australia, England, and the United States, the last being the principal producer; 150 grams of radium, costing about 20 million dollars, have been consumed in the United States, of which 90 per cent. was produced from the carnotite ores of Colorado and Utah. Last year five companies were concerned in the industry; the total capital expended on mines and plant was 10 million dollars. Some 200 to 400 tons of ore have to be treated to produce one gram of radium, there being only about 2 per cent. of uranium oxide in the ore, and only one part of radium to 3,200,000 parts of uranium.

Much larger deposits of ore were discovered in 1913 near Elizabethville, in the Belgian Congo, but before commercial operations could be commenced the war broke out and prevented the exploration and development of the radium properties. The outcome of the war could not be accurately predicted; hence the Belgians endeavoured to keep their discoveries secret, thinking that should the war be lost they might still control the output of radium.

After the war, the company recruited its staff and commenced development. The policy of secrecy was still maintained, however, and no announcement was published until the largest plant in the world for the treatment of radium ore had been completed at Oolen, Belgium, and the Belgian company was in readiness to start production.

The announcement of the Belgians was received by American producers with considerable concern. It was immediately recognised that the African deposits must be of considerable size to warrant the erection of the Oolen plant. While the Belgians must transport their ore 2,000 miles down the Congo River, across the ocean to Antwerp and thence by rail to Oolen, this procedure is much more economical than endeavouring to treat the ore in the heart of Africa, and notwithstanding this long haul, Belgian radium can undersell the American product by a large margin. A conference between representatives of the American companies and the Belgians resulted in the Radium Company of Colorado forming a joint selling organisation with the Belgians, and the new company will market radium throughout the world. With the appearance on the market of the Belgian product, the American mines shut down, and the price of radium dropped to $70 per milligram, the lowest price on record. The world needs radium to combat cancer, and it was recognised that the lower the price the more widespread would be the use of this valuable agent.

New Western Union Cable Vessel.—It is stated that the Western Union Telegraph Co. has given a contract for a cable layer to the Société des Chantiers de Saint-Nazaire. This contract is of particular interest, since it is the first time that a cable company has had such a vessel built in France. —*Reuter's Trade Service* (Paris).

BUSINESS NOTES.

Bankruptcy Proceedings.—Percy Charles Letherbarrow, trading as Letherbarrow Brothers, 1, Church Lane, Banbury, electrical contractor.—The receiving order in this matter was made on February 21st on debtor's own petition. The first meeting of creditors was held on March 21st at 1, Saint Aldates, Oxford. The following are creditors:—

	£		£
Bankers	45	Purnell, A. E.	50
Bill & Berry	87	Thomas, J. H.	23

Roy Evrett Brace, 314, Bromford Lane, West Bromwich, engineer's merchant.—The first meeting of creditors was held on April 13th at Birmingham. According to the statement of affairs, the liabilities amounted to £857, and there were no assets. It appeared that debtor commenced business in March, 1919, as an engineer's merchant with £100 capital, of which £50 represented his savings, and £50, a gift from his wife. The business consisted chiefly of electrical and engineering work, contracting for the erection of lifts, heating apparatus, &c. In some cases contracts were undertaken at unremunerative prices, the materials necessary for the work being obtained on credit. No prime cost or estimate books appeared to have been kept. The matter was left with the Official Receiver as trustee.

Lewis Sagar, 143 and 143a, East Street, Walworth, dealer in electric lamps.—The creditors met on April 13th at the London Bankruptcy Court under this receiving order. According to the debtor's statements, he was born in Russia, and came to England in 1914 with a capital of £100. At the end of 1921 he disposed of his then business, and, after settling his debts, was left with £600. He next took premises at 86, York Road, S.W., and in January, 1922, began trading there in electric lamps in verbal partnership with another person. The lamps were manufactured in Austria, and, after they had imported £650 worth, they learned that a similar lamp was already patented in this country. They were thereby prevented from putting their lamps on the market, and eventually disposed of them at a loss of £300. He had since carried on business as a hardware dealer. The failure was further ascribed to loss of £300 by robbery. The debtor returns liabilities £623 and assets nil. In the absence of any offer, the case was left with the Official Receiver to be wound up in bankruptcy.

James Ashton Johnson, 1, Dragon Parade, Harrogate, engineer.—The receiving order in this matter was made on March 29th on debtor's own petition. The statement of affairs shows liabilities of £89, while the assets, amounting to £5, are all absorbed by the preferential claims. Debtor attributes his failure to high rent and wages, drop in his wages and unemployment of two sons. It appears that he commenced business on his own account as an electrical engineer at 1, Dragon Parade, Harrogate, in February, 1919, with no capital, buying such goods as were needed for immediate use on credit. Since August, 1919, he appears to have been in employment and to have devoted only his spare time to the management of the business. No books of account were kept. He states that he first became aware of his position when he obtained an administration order in the Harrogate County Court in March, 1922, under which he was ordered to pay his debts in full by instalments of £2 per month. He says the order was varied to 10s. per month last February. Instalments to the amount of £10 10s. were paid under the order. The household furniture is claimed by his wife.

Walter Greathead, Belford Street, Burnley, and Oswald Greathead, Brierfield, lately carrying on business as electrical engineers and contractors.—At Burnley County Court, on April 12th, the Judge made an order for the annulment of this bankruptcy. The creditors had accepted a composition of 6s. 6d. in the £, which his Honour approved of, the Official Receiver stating that the proposal was reasonable and for the benefit of the estate. The liabilities were £224.

A. C. Ince (formerly trading as the Newcastle Electrical Engineering Co., now with a partner under the style of the Tyne Electrical Industries), electrical contractor, 21, Fenkle Street, Newcastle-on-Tyne.—Last day for proofs for dividend, April 30th. Trustee, Mr. C. Woollett, Official Receiver, 4, Northumberland Street, Newcastle-on-Tyne.

J. Bakewell, electric light and power engineer, 43, Waterside Road, Barton-on-Humber.—First dividend of 2s. 1½d. in the £, payable at the Official Receiver's Office, St. Mary's Chambers, Great Grimsby.

M. Watkinson, H. Watkinson, and A. Watkinson (Watt and Co.), electrical and mechanical engineers, 22 and 24, Palmer Road, Sheffield.—Trustee, Mr. T. C. Parker, junr., 36, Bank Street, Sheffield, released February 27th.

C. J. Haxby and E. Brady (Haxby & Brady), electrical engineers, 1a, East Parade, Harrogate.—Last day for proofs for dividend, April 28th. Trustee, Mr. D. S. Mackay, Red House, Duncombe Place, York.

Company Liquidations.—Ledward & Beckett, Ltd.—Winding up voluntarily for reconstruction purposes. Liquidator: Mr. C. E. Smedley, Bush Lane House, Bush Lane, E.C.4, who is authorised to consent to the registration of a new company, to be named Ledward & Beckett (1923), Ltd., and to enter into an agreement for sale and to carry this into effect. Meeting of creditors, April 25th. Particulars of claims to the liquidator by April 30th. All claims have been or will be paid in full.

Standard Electric Sign Co., 62, Oxford Street, W.—The statutory first meeting of the creditors and shareholders of this company were held on Tuesday at the Bankruptcy Buildings, Carey Street, W.C., a winding up order having been made last February on a shareholder's petition. Mr. J. Barwick Thompson, Official Receiver, reported that the company was formed in July, 1921, to carry on business as advertising contractors, its principal object apparently being to erect advertising signs on tramway and electric lamp standards, and to use those standards for the purposes of advertisement. The promoter was Mr. H. T. Hart Spratt, who also acted first as joint managing director at a salary of £500, and after June, 1922, of £1,440 per annum, but no part of the increased salary was paid. The capital of the company was increased from £500 to £2,000 in October, 1921, and to £25,000 in July, 1922, but the issued capital was only £6,298, and the company was carried on by means of loans and of deposits received from advertisers. Apparently the method of business was for the company to approach municipal corporations and tender for the use of electric lamp or tramway cable standards at a rental, and then approach business firms with a view to obtaining contracts for advertisements. The deposits received from those firms carried on the company during the first year of its existence. Only some small sums had been paid to the municipalities, but a large number of contracts were entered into with business firms for advertising their commodities on these standards. Throughout, added the chairman, the company never had sufficient capital to carry out its ambitious programme, and its business had been carried on in a slipshod and unbusinesslike manner. The failure was entirely attributable to mismanagement on the part of the directors; the most elementary duties of directors were not carried out, and there were many matters calling for strict investigation at the hands of the Official Receiver. The accounts filed under the liquidation showed unsecured debts £7,463, against assets £90, consisting of book debts, all the other assets having been sold under executions. The deficiency with regard to shareholders was returned at £13,761. The liquidation was left in the hands of the Official Receiver.

Private Arrangement.—Alfred James Barlow, electrical engineer, trading as Barlow Bros. & Co., 9, Brunswick Place, City Road, London, E.C.—The creditors interested herein were called together on April 16th, when the representative of Messrs. Clark, Hunt & Co., one of the principal creditors, was elected to the chair. An approximate statement of affairs was presented by the debtor's solicitor, which showed liabilities to the trade of £1,659, and preferential claims of £75. The assets amounted to £2,631, or a surplus of assets over liabilities of £897. The assets were as follows: Stock-in-trade, £607; plant and machinery, £700; fixtures, £50; work in progress, £313; good book debts, £950; cash at bank, £2 1s. 10d.; and cash in hand, £10 16s. 10d. It was stated that the meeting had been called as a creditor for more than £100 had obtained judgment. The debtor, it was stated, commenced trading about 12 years ago, and for a long time was successful. Lately he had been pressed by creditors, and he attributed his position to bad debts, losses on contracts, and the slump in trade. A balance sheet was prepared at the end of December last, and it showed that there had been a slight loss on the trading during the preceding six months. In the absence of any offer of composition it was decided that the debtor should be requested to execute a deed of assignment in favour of Mr. A. Wilmott, of Messrs. Francis, Nicholls, White & Co., C.A., 14, Old Jewry Chambers, E.C., while a committee was nominated consisting of the representatives of the Sloan Electrical Co., Ltd., Metal & Hardware Products, Ltd., Metacon Patent Glazing Bar Co., C. J. Ferguson & Sons, and Holme & Roland. The principal creditors are:—

	£		£
Clark, Hunt & Co., Ltd.	83	Metal & Hardware Products, Ltd.	205
Sloan Electrical Co., Ltd. ...	79	London Electric Co., Ltd. ...	64
Holme & Roland	127	Metacon Patent Glazing Bar Co.	80
Ferguson & Sons	166		

Dissolution of Partnership.—Compactum Radio Co., wireless manufacturers, 44, Station Road, Wood Green.—Mr. J. A. Clark and Mr. J. Hague have dissolved partnership.

Sequestration.—R. Walker, motor engineer and electrician, West End Garage, Peacock Cross, Hamilton.—The estates were sequestrated by the Sheriff Substitute of Lanarkshire at Hamilton on April 10th. Meeting to elect trustee and committee, April 20th, at the County Building, Hamilton. A composition may be offered at the meeting.

Trade Announcements.—Mr. H. S. Ingleby states that he has purchased the whole of the wireless stock of Messrs. Ingleby & Co., Ltd., together with the office and showroom fittings at 1, Albion Street, Leeds, and taken over the premises. He will continue as life director and secretary of the company. Manufacturers' lists are asked for.

Messrs. Fernand Espir have removed to 68, Coleman Street, E.C.2. Their new telephone numbers are London Wall 904 and 905.

Messrs. McKeand & Foulger, who have commenced business as electrical and motor engineers at 29, Water Street, Blackburn, wish to receive catalogues and lists, &c.

Mr. Charles Gates has opened premises at 29, St. Giles' Street, Norwich, where he has a stock of electrical fittings and accessories, and a wireless demonstration parlour.

Catalogues and Lists.—Western Electric Co., Ltd., Connaught House, Aldwych, W.C.2.—An artistically-produced booklet containing designs for ornamental loud speakers.

Messrs. A. D. Lang, Ltd., 42, Berners Street, Oxford Street, W.1.—An illustrated booklet containing a description of "Macbeth" artificial daylight for colour-matching purposes, &c.

Messrs. R. A. Lister & Co, Ltd., 53, Victoria Street, S.W.1.—An illustrated brochure dealing with applications of the "Lister-Bruston" automatic electric lighting plant.

The Electrical Apparatus Co., Ltd., Vauxhall Works, South Lambeth Road, S.W.8.—Leaflet H19P/6, giving an illustrated description of "Vauxhall" control pillars for d.c. motors.

Messrs. Veritys, Ltd., Aston, Birmingham.—The first complete catalogue issued by the firm since the war. It consists of 240 pages of concise information relating to power, control, and illumination—motors, switchgear, industrial lighting fittings, fans, &c. It is prefaced with a few pages of useful data, and rounded off with an index. A large number of illustrations appears.

Messrs. W. H. Sugden & Co., Ltd., Glenny Road, Barking.—A stock list of a.c. motors and d.c. motors and dynamos.

The Sun Electrical Co., Ltd., 118-120, Charing Cross Road, W.C.2.—April price list of electrical supplies, including radio valves, switches, lampholders, cut-outs, fuseboards, cables, &c.

The Midland Electric Manufacturing Co., Ltd., Barford Street, Birmingham.—An illustrated pamphlet describing a new pattern of "Kantark" distribution board.

Messrs. Ferguson, Pailin, Ltd., Higher Openshaw, Manchester.—Catalogue Section 60 A1, illustrating and describing field-breaking switches for circuits of up to 650 V.

The London Telephone (New System) Co., Ltd., Donington House, Norfolk Street, Strand, W.C.2.—An illustrated leaflet advertising the firm's inter-communication system.

Messrs. Ransomes, Sims & Jefferies, Ltd., Orwell Works, Ipswich.—An illustrated mailing card advertising d.c. dynamos and motors.

The British Electric Transformer Co., Ltd., 50, Oxford Street, W.1.—An illustrated and priced pamphlet dealing with two types of electric cooker for domestic purposes, and an electric kettle.

From the Enfield Ediswan Cable Works, Ltd., of Central House, Finsbury Square, E.C.2, we have received a wall calendar with monthly tear-off sheets from March to December, 1923. Each sheet is also a quarterly calendar. The pictorial design includes views of the company's cables in course of laying, and of the works in which they are made.

Russian Electric Steel.—The State works, known as the Electro-Steel, is the only works of its kind in Russia which produces special qualities of steel. According to a report of the turnover of the works in the last quarter of 1922, difficulties were experienced in disposing of the production down to October, but matters in this respect slightly improved in the last two months, although the sale prices are said to have been high.

A Russian Electrical Credit Company.—At the recent first meeting of the Electrical Credit Co. in Moscow the directors were authorised to take steps for securing adequate working capital and for obtaining loans from the State. It was mentioned that the State Bank had expressed a wish to participate in the company to the extent of 50 per cent. of the share capital. This was admitted to be desirable provided that the assumption of such an interest would not make any alterations in the basic principles of the company's activity, and with this point in view the directors were empowered to enter into negotiations with the State Bank.

Employment in Swedish Engineering Industry.—The official statistics published in the *Swedish Economic Review* for the March quarter show that at January 1st, 1923, the total number of employés in the mechanical industries of Sweden was 28,200, as compared with 26,400 at October 1st, 1922. During the period referred to workers in machine shops increased from 18,400 to 19,900; those in the electrical industry from 4,200 to 4,400; and those in shipyards from 3,700 to 3,900. At the beginning of 1923 wages were, roughly speaking, 40 per cent. lower than the highest figures for 1920.

Electrifying the Queensland State Mine.—In an attempt to capture the coal markets of the East, the Queensland Government intends to equip the State coal mine at Bowen with electric light, electric coal cutters, and electric locomotives. Mr. J. W. Brophy, general superintendent of the Queensland State Coal Mine, has made an exhaustive inspection of the Maitland (N.S.W.) fields and their equipment.—*Reuter's Trade Service* (Melbourne).

Steel Trade Improvement.—In the course of their report for the year 1923 the directors of Hadfields, Ltd., state: "The engineering dispute, which lasted 13 weeks (March 11th to June 13th, 1922) had a very serious effect on the company's operations. The great and protracted shortage in the demand for steel and engineering products generally has also caused your directors much anxiety. There are now, however, marked signs of improvement in this direction."

Yorkshire District Industrial Council.—At the meeting of District Council (No. 2) for the Electricity Supply Industry (Yorkshire, &c.), at Sheffield, on April 11th, an intimation was received from the York Electricity Committee that it wished to abandon its membership of the Council. The matter is to be reported to the National Council with a view to persuading the York E.C. to alter its decision.

A copy of an application for permission to increase the price of electricity was received from the Ilkley U.D.C. The secretary stated that the District Council had opposed the application as the Ilkley U.D.C. had not adopted the rates and conditions laid down. The annual meeting is to be held at Leeds on May 9th.

The Electrical Development Association.—The officers for the year 1923-24 are: President, Mr. W. B. Woodhouse, M.I.E.E.; vice-presidents, Ald. W. Walker, A.M.I.E.E., and Mr. A. F. Berry; and chairman, Mr. S. T. Allen, M.I.E.E. The following are new members of the Council: B.E.A.M.A., Messrs. E. E. Sharp and F. Wallis; I.M.E.A., Mr. R. B. Mitchell; London Companies, Major Richardson; Power Companies, Mr. E. Boys; Provincial Companies, Mr. H. Bentham; Lamp Makers, Mr. P. J. Brewer; and Wholesalers' Federation, Mr. R. Smith.

In our advertisement columns to-day particulars are given of an "electrical slogan" competition which has been arranged by the British Electrical Development Association. The advertising value of a good "catch phrase" is well known; what is wanted is a slogan which will appeal to the non-electrical person. "Use Electricity" is all very well in its way, but it lacks that unspoken implication which is the soul of a successful slogan. Such phrases are the result of inspiration, and not of elaboration of an idea.

Book Notices.—"Wireless Telephones," by J. Erskine-Murray, D.Sc., &c. (84+16 pp.). London: Crosby Lockwood and Son. Price 4s. 6d. net.—This is a third edition of a work in which an attempt is made to convey a general idea of what wireless telephony is in a small space and in a "popular" manner. By a copious use of analogies, the principles of the art are explained, and, on the practical side, many hints on the working of apparatus are given.

"Special Steels," by Thos. H. Burnham, B.Sc., Hons. (London). With a foreword by Sir Robert Hadfield, Bart., upon whose researches the work is chiefly founded. (194 pp.; 40 figs.). London: Sir Isaac Pitman & Sons, Ltd. Price 5s. net.—In a comparatively small compass the author has made a review of an industry which is rapidly assuming more important proportions. The material upon which the book is based has been taken for the greater part from the various papers, &c., written by Sir Robert Hadfield; a list of these is given in an appendix. After a few preliminary remarks upon the importance of iron and steel, the author deals generally with the constitution and manufacture of special steels—mechanical and heat treatment, rolling, annealing, &c. The following chapters treat of nickel steel; chromium steel; silicon steel; manganese steel; tungsten steel; other ternary steels; nickel-chromium steel; chromium-vanadium steel; and high-speed tool steel. The final chapter is devoted to a review of recent developments, showing the trend of progress and touching upon such matters as the examination of steels by X-rays, spectroscopic analysis, colloidal chemistry, &c. The first appendix is devoted to carbon steel; the second is the list of Sir Robert Hadfield's papers previously referred to; Appendix III is a list of symposia of the Faraday Society; and the last appendix is a comparative table of physical and mechanical properties of a number of types of steel. The volume concludes with a short bibliography and an index.

"The Colliery Year Book and Coal Trades Directory" (pp. lxxx+844). London: The Louis Cassier Co., Ltd. Price 21s. net.—This is a first edition of a directory of considerable size which is likely to be of great service to all in the coal industry or connected therewith. It will be sufficient to mention a few of the sections to show the scope of the year-book. At the commencement a full list of the personnel at the headquarters and of the inspection department of the Mines Department is given. There follows particulars of owners' and miners' associations; an alphabetical list of colliery owners and officials; Home Office Regulations; a review of the mining industry during 1922; statistical tables of resources, production, exports, costs, consumption, &c.; and the terms of settlement of the dispute of 1921. About a hundred pages are devoted to articles of a technical nature, and these include "Electricity in Mines," by Major E. I. David, M.I.E.E.; "Electric Winders for Collieries"; "Low Temperature Carbonisation"; and "Lighting in Mines," by H. W. Richardson, A.M.I.E.E. There is also a list of scientific and technical institutions, and a short directory of electricity supply undertakings, with the names of the chief engineers. This brief summary does not exhaust the information contained in the volume, which is a veritable cyclopædia of mining data.

"Practical Electric Light Fitting," by F. C. Allsop. (Pp. 288). London: Sir Isaac Pitman & Sons, Ltd. Price 7s. 6d. net.—This is the ninth edition of a work claimed to have been the earliest of its kind; it was originally published in 1892. The present edition, naturally, bears very little resemblance to the first, except in its arrangement. The revisions in the present edition are of a minor nature; the work now describes all the modern surface wiring systems, types of electricity meters, testing sets, &c. The book is essentially practical; theory plays but a small part in its scheme.

"The *Journal* of the Junior Institution of Engineers." Vol. XXXIII, Part VII, April, 1923. Pp. viii+56. London: Percival Marshall & Co. Price 2s.—This part contains a portrait and short biography of the President, Capt. M. P. H. Riall Sankey, C.B., C.B.E.; a paper on "Rolling Mill Machinery," by R. C. D. Fell; reports of "lecturettes" on "KVA and its Measurement," by G. F. Shotter; "The Characteristics, Operation, and Maintenance of Underground Cables," by A. J. Tracey, &c.; notes of visits to works, &c.; and proceedings of local sections.

"Electric Cranes and Hauling Machines," by F. E. Chilton, A.M.I.E.E. (114 pp.; 49 figs.). London: Sir Isaac Pitman and Sons, Ltd. Price 2s. 6d. net.—The opening chapters of this little work deal with general considerations in the application of electricity to hauling, hoisting, and conveying machinery, and such points as motors, braking, and control are briefly dealt with. Departing from the general to the particular, the author proceeds to describe overhead travelling cranes; electric transporters; "Goliath" cranes and underhung jib cranes; level luffing jib cranes; accessory appliances for cranes; electric capstans; electric winches; and electric haulages and winding gear. In each section full consideration is given to standard systems, and many diagrams and illustrations accompany the descriptions.

"Electric Wiring," by W. C. Clinton, B.Sc., M.I.E.E. (198 pp.; 105 figs.). London: John Murray. Price 3s. 6d. net.—The seventh edition of this "primer for the use of wiremen and students" has undergone but little alteration. The new notation for cables has been substituted for the old, and the sections relating to arc and incandescent lamps have been revised.

"Post Office Electrical Engineers' Journal." Vol. XVI, Part I. April, 1923. London: Electrical Review, Ltd. Price 2s. net.

"Mercury Ores." by E. Halse. Pp. ix+101. London: John Murray. Price 5s. net.

"The Dynamo: Its Theory, Design and Manufacture," by C. C. Hawkins. Vol. II. Pp. xvi+322; figs. 442. Price 15s. net. "Costing and Price-Fixing," by J. M. Scott-Maxwell. Pp. xii+211; 21 figs. Price 5s. net. "Electric Motors: their Theory and Construction," by H. M. Hobart. Vol. I. "Direct Current," third edition. Pp. xvi+412; 373 figs. Price 15s. net. London: Sir Isaac Pitman & Sons, Ltd.

"Science Abstracts," A and B. Vol. XXVI. Part 3. No. 303. March 25th, 1923. London: E. & F. N. Spon, Ltd. Price 3s. each.

"The *Transactions* of the South African Institute of Electrical Engineers" (February, 1923). Johannesburg: The Institute. Price 2s.—This issue reproduces Mr. W. A. Gillott's paper (read before the I.E.E.) upon "Domestic Load Building"; papers on "Lourenco Marques Time Signals," and "Some Characteristics of the Thermionic Valve"; and a discussion on a paper, "Operating Experience of the System of the Rand Electric Power Companies."

A New Association.—According to announcements appearing in the Birmingham newspapers, an association of large users of brass and copper (sheet and strip) has been formed to secure mutual co-operation and to promote the welfare and interests of members in relation to supplies of sheet and strip brass and copper. Manufacturers using 140 tons per annum, or more, are invited to write to the secretary, Mr. Percival P. Richards, F.C.A., Box 18, Chamber of Commerce Buildings, Birmingham.

Duplex Mono Recorder.—Messrs. James Gordon & Co., Ltd., have recently acquired the licence for the manufacture and sale in Great Britain of the duplex mono recorder flue gas analysis apparatus which automatically records on one chart both CO_2 and combustible gases. A pamphlet is in course of preparation.

Electricians' Wages.—The *Daily Dispatch* states that by an award of the Industrial Court the wages of electrical fitters, electricians, wiremen, and equivalent grades in the No. 2 Area will be increased by 3½d. per hour. The negotiations arose out of the fact that in many cases these skilled workers were getting less pay than many semi-skilled men. The men asked that their wages should not be governed by the standard district engineering rate, and this has been conceded by the Court.

Swedish Turbines for Russia.—*Dagens Nyheter* learns that Karlstads Mekaniska Verkstad has received an important order for eight large turbines for Russia. The first of this number, now under construction at Kristinehamn, is one of the largest so far made in Sweden, having a capacity of 11,800 h.p. This turbine will be exhibited at Gothenburg.—*Reuter's Trade Service* (Stockholm).

New Zealand's Trade with Germany.—The Wellington (N.Z.) Chamber of Commerce has urged the Government to postpone the lifting of the embargo on trade with Germany until January next, on the ground that merchants have already ordered goods for next Christmas trade, and great loss will be entailed if German manufacturers are allowed to enter the country before then.—*Reuter's Trade Service* (Melbourne).

Mr. W. L. Hichens on the Industrial Position.—In the course of his speech at the annual meeting of Cammell Laird and Co., Ltd., at Sheffield, on April 11th, Mr. W. L. Hichens, the chairman, said that up to the present their hopes that 1923 would be an improvement on 1922 had been justified so far as the volume of work was concerned. In the steel industry and in the railway carriage and wagon business orders were certainly more plentiful than a year ago, although the flicker in shipbuilding seemed to have died down. The French and Belgian operations in the Ruhr district had temporarily stimulated the iron and steel and coal industries of this country, orders having been diverted here which would otherwise have been placed abroad, but the speaker expressed the belief that our industries would have been better off in the long run if the French had not embarked upon their great adventure. Our own prosperity depended ultimately upon the peace, order and progress of the whole world. The industrial weather, in Mr. Hichens's opinion, was as unfavourable as ever and they were not justified in looking with any confidence to a long-continued improvement. The prices at which orders were taken in their industries were still so low that, as a rule, they yielded no profit. They were able to show a profit of £145,000 for the past year because the accounts included the results of contracts taken in more fortunate times, and because it sometimes happened that by skilful management and good buying of materials a contract which threatened loss was brought to a more fortunate issue. That had happened several times with them. In referring to the company's various investments Mr. Hichens said that these had not been materially altered during the year. The Tranmere property, their shareholding in the Midland Railway Carriage & Waggon Co., and their holding in the English Electric Co. made up together about four-fifths of the total under that heading. They had every reason to be satisfied with the results of the Midland Railway Carriage & Waggon Co. During the year Mr. Bailey became managing director of these works, as well as of the Nottingham Carriage & Waggon factory. The co-ordination that he had been able to achieve between the two works had been of the greatest possible benefit. Bearing in mind the scarcity of orders and the famine prices which resulted from keen competition both places had done remarkably well, and it was quite clear that they had established themselves in a strong position for securing future orders. The English Electric Co. had, of course, suffered from the prevailing depression, but under the circumstances the results of the year appeared to have been satisfactory.

The speaker, in alluding to the contingent liability for calls in the United Steel Corporation of Asia, Ltd., in which they were interested jointly with Messrs. Bird & Co., said that the condition of the iron and steel market in India at present was such that there was no immediate likelihood of an active development. They did not anticipate, therefore, that any further calls of more than a trifling amount would be made in the near future. Some day, however, the great deposits of iron ore, coal, and limestone in India would be developed, and they should be in a position to participate in that development.

Austrian Companies.—The Cable Works and Cable Industry Co., of Vienna, has decided to pay a dividend at the rate of 28 per cent. for 1922, being the same rate as in the previous year. The net profits of the Felten & Guilleaume Co., of Vienna, are returned at 3,397 million crowns for 1922 and the dividend is at the rate of 3,000 crowns per share.

British Trade Mark Applications.—The following are included among the recent applications for British trade marks. Objections may be lodged within one month from the dates mentioned:—

Wal-Kall. No. 431,146. Class 11. Electric bonding boxes of ordinary metal.—The Walsall Hardware Manufacturing Co., Ltd., Hatherton Works, Ablewell Street, Walsall, April 11th, 1923.

Electrodrome. No. 432,658. Class 18. Electric lighting installations, electric heating and cooking appliances, electric bell systems, and electric arc welding plant.—John C. White, 1, Cumberland Street, Deansgate, Manchester. April 11th. 1923.

Morsophone. No. 428,949. Class 8. Electrically-operated apparatus for teaching the Morse code.—Walter Grafton, and Son, Ltd., Footscray Road, Eltham, London, S.E.9. April 11th, 1923.

Ampliphone. No. 433,422. All goods in Class 8.—Harry W. Harris, 63, Tyrwhitt Road, St. John's, London, S.E.4. April 11th, 1923.

Sentinel. No. 434,055. Class 8. Wireless instruments and apparatus and electric accumulators.—Sentinel Trading Co., Ltd., Sentinel House, Southampton Row, London, W.C.1. April 11th, 1923.

Duply. No. 433,951. Class 50. Electric insulating materials.—H. D. Symons & Co., Ltd., 196, Deansgate, Manchester. April 11th, 1923.

Foreign Exhibitions.—The Organising Committee of the Cologne Fair proposes to hold the Fair from September 9th to 15th instead of from May 6th to 12th. This decision is stated to be due to the unsettled conditions in the Occupied Territory and the difficulty of communication with the rest of Germany.—*Reuter* (Cologne).

Switzerland.—The Seventh Samples Fair opened at Bâle on Saturday last, and will be continued until April 24th. An especially interesting section is devoted to electricity. The machinery and transport sections also afford many objects of much interest. Some 900 Swiss firms are represented, including the principal concerns of the country.—*Reuter's Trade Service* (Bâle).

New French Companies.—There has been formed at Paris (25, Rue de la Pépinière) a company styled Electro-Chimie de Brignoud, with a capital of 7,100,000 fr., for the manufacture of electrometallurgical and electrochemical products, and the generation and application of electrical energy.

With a capital of 1,000,000 fr. has been embodied at Paris (17, Rue d'Athènes) the Nord Africaine d'Electricité, Gaz et Eau, a company which proposes to produce and utilise electricity, gas, and water in North Africa.

Milletre et Dive is the style of a company formed at Paris (283, Rue des Pyrénées) for trade in magnetos and insulating substances. Capital, 188,000 fr.

There has been established at Decize (Place du Champ du Foire) the Union Electrique du Nivernais, with a capital of 650,000 fr., to take over from the Société d'Electricité de Decize an electric light and power business.

The Woman's Exhibition.—The second Woman's Exhibition, organised by the *Daily Express*, was opened at Olympia on April 12th. Although from a general point of view the show is as good or better than last year's, the electrical side has been sadly neglected. Electric cooking seems to have been avoided altogether, and heating is inconspicuously represented on one or two stands by small bowl fires. Vacuum cleaners are represented; in addition to the "Hoover" and "Eureka," Messrs. Gillespie & Beales show "Nilfisk" cleaners of stationary and portable patterns. On two other stands a low-priced German product has made its appearance. Electric washing is demonstrated by Messrs. Beatty Bros., Ltd., with "White Cap" and "Red Star" washers and ironers. Messrs. Frank Feesey & Co. also show "Cascade" washers and ironers.

Messrs. Chas. Fer & Co., Ltd., have a varied collection of small appliances of Continental manufacture, including fans, irons, kettles, and lighting fittings, and the toy cooker recently mentioned by us in connection with another exhibition. The Rogers Electric Sales Co. (Great Britain) shows high-frequency electro-medical apparatus, vacuum cleaners, fans, immersion heaters, &c. A similar stand is that of the Sterling Corporation (Great Britain), Ltd., which shows h.f. apparatus, immersion heaters, and radio apparatus (a small display). Messrs. Dale, Forty & Co., Ltd., exhibit "Radio-Teleola" cabinets for wireless reception, as well as panels. An electric gramophone with an automatic switching-off device (the "Electromophon") is exhibited by Purcar, Ltd.

Local Exhibition.—Grimsby.—An electrical exhibition, organised by the Corporation Electricity Committee, was held at the Town Hall from April 9th to 12th, and eight local contractors took part in it. Lectures on the use of electricity for domestic purposes were given by Lt.-Col. Vignoles, D.S.O. (borough electrical engineer), and Mr. Leak, of the British Electric Transformer Co., Ltd., and demonstrations of cooking were also arranged. The Corporation supplied electricity *gratis* and carried out the advertising of the show. It is reported that many sales have resulted from the exhibition, including 25 cookers of the "Tricity" pattern.

The Theatre Royal, Manchester.—Referring to the article on the electrical equipment of this theatre which we published in our issue of March 30th, Mr. J. C. Elvy, M.I.E.E., who collaborated with Mr. J. W. Barber, C.B.E., as consulting engineers, informs us that the following firms supplied parts of the equipment:—Messrs. C. B. Davis Cash & Co. (fittings); Messrs. Hunter & Hyland, Ltd. (curtain motor gear); Messrs. Austin Walters & Son (electric signs and fire shutters); Messrs. J Frank Brockliss, Ltd. (arc projectors, erected by the Cinema Engineering Equipment Co.); the Sturtevant Engineering Co., Ltd. (vacuum cleaning equipment); and Messrs. Keith Blackman & Co. (ventilating and heating apparatus).

For Sale.—Wolverhampton Corporation Tramways Committee has for disposal a number of single-deck single-truck tramcars equipped with G.E.C. motors.

Messrs. Veryard & Yates, Ltd., will sell by auction on May 2nd and following days at Ravenswood Road, Balham, electrical equipment, wireless, telephone and telegraph material, &c.

Bradford Corporation has for disposal one Corliss vertical engine coupled to a 1,000-kW Westinghouse d.c. generator, with condenser, pumps, &c., and one 380-kW Willans-E.C.C. d.c. generating set, &c. (See our advertisement pages to-day.)

Price Reductions.—The Aster Engineering Co., Ltd., announces a reduction in the price of the "Aster British Light" generating plant.

Messrs. C. A. Vandervell & Co., Ltd., announce reductions in the prices of the standard model "Ford" battery and the "model de luxe" pattern, with Willard threaded rubber separators.

LIGHTING AND POWER NOTES.

Australia.—Hydro-Electric Scheme.—A scheme is in hand for utilising the Snowy River for generating electricity. A dam will be built below Jindabyne 150 ft. in height, with a flow of 1,100 cu. ft. per second. It is estimated that the total power obtainable is 200,000 h.p.

Victoria.—The Victorian Government has decided to set aside £100,000 to enable the Electricity Commissioners to extend high-pressure mains and low-pressure distributors to country centres desirous of using current from Morwell. Applications have been received from 16 rural municipalities desirous of taking advantage of the power supply, and varying schemes have been prepared to meet their needs, each being based on an existing assured market.—*Reuter's Trade Service* (Melbourne).

Melbourne (Vic.).—The electricity supply undertaking of the City Council for the year ended December 31st, 1922, showed a gross profit of £160,124, or an increase of £58,333 over the year 1921. The Council has decided to reduce, as from April 1st, the price of electricity for other than lighting purposes by 0.3d. per kWh, and by ¼d. per kWh for lighting. The Electric Light Committee has recommended a reduction of 20 per cent. on the hire charges for electric motors.—*Reuter's Trade Service* (Melbourne).

Bradford.—New Plant.—At the City Council meeting last week, the deputy chairman of the Electricity Committee stated, in connection with the proposed expenditure of £190,649 for new plant, that consumers were increasing at the rate of a hundred per month. The plant was capable of dealing with a maximum load of 33,000 kW, but it was estimated that next winter the demand would be for 36,000 kW and for 40,000 kW a year later. The use of water power for generating purposes had been suggested, but it was out of the question. Alderman R. Johnson said that he hoped this would be the last expenditure on the Valley Road works, and trusted that the Electricity Committee would in future look to the Apperley Bridge site, which offered better opportunity for developments.

Bristol.—Extension of Mains.—The Electricity Committee proposes to borrow £120,000 for the extension of mains during the next three years.

Burton.—Extension of Supply.—The Town Council has agreed to give a supply of electricity to the Coton Park Colliery at a cost of £3,500. The company will pay £1,500 the first year and £3,000 per annum for the next four years.

Calne.—Electricity Supply.—The Town Council has decided to oppose the application of the promoters of the West Wilts. Electricity Order, and to have its own Order prepared and deposited forthwith.

Canada.—New Power Company.—A company has been incorporated under the name of the Hawkesbury Industrial Corporation, Ltd., to develop electric power for lighting and manufacturing purposes at the town of Hawkesbury, on the Ottawa River. Mr. Edmond Proulx, L'Original, Ontario, is the chief promoter of the company, the capital of which is $100,000.—*Reuter's Trade Service* (Ottawa).

Cardiff.—Wiring of Houses.—The Town Council has decided to extend its electricity mains to the Ely housing site, both for public and private lighting.

Continental.—France.—A Bill to open a credit of 600,000,000 fr. for the establishment of rural electricity supply networks has recently passed the French Chamber. The money will be granted in the shape of loans to the bodies formed by the departments or communes interested, who will guarantee the repayment and interest. The loans granted will not exceed half the capital subscribed in each case, and will be repayable within 30 years.

Application for a concession to distribute electricity in 17 communes of the department of the Ain has been made by the Syndicat Inter-communal de Saint André de Corcy.

Messrs. Petitjean Frères, manufacturers, of Montagney (Doubs), have applied for a concession to supply electricity for all purposes to 24 communes, four being situated in the neighbouring Haute Saône department.

The plans are now being prepared for the electrification of 57 communes in the department of the Allur. Electrical energy will be furnished to 30 of these communes by the Scieries et Usines Hydroélectriques de la Sioule and to the remainder by the Société d'Electricité Générale de Saint-Etienne.

Russia.—It is announced from Petrograd that the North-Western Economic Council has under consideration the extension of the "Red October" station (the former Utkina works), which is the only station in the district which is operated

with peat fuel. It is intended to increase the capacity of the station to 20,000 kW, and for this purpose application has been made to the Council of Labour and Defence for the delivery of the 10,000-kW turbo-generator ordered abroad, and for the opening of credits by the National Commissariat of Finance for the working of the station.

As a result of the difficulty in obtaining fuel, the administration of the municipal undertaking at Kieff has proposed a scheme for the utilisation of the River Desenke for generating electricity. The district Economic Council has suggested to the authorities that the project should be subsidised and measures taken for its completion in two months.

The Ural Industries Bureau has agreed to grant a concession to a French company to erect a power station in Ekaterinburg. A scheme is in hand for the construction of another power station in the town to supply energy for both public and district industrial purposes.

Crowthorne (Berks.).—Electricity Supply.—The York Town and Blackwater Gas Co. is making a canvass of the residents of Crowthorne and Sandhurst, with the object of ascertaining the probable number of consumers of electricity.

Darfield (West Riding).—Electricity Supply.—The Urban District Council has applied to the Yorkshire Electric Power Co. for terms on which it would be prepared to supply electricity in the district.

Dumfries.—Increased Electricity Charges.—The Town Council has decided to increase the charges for electricity from 7d. to 8d. per kWh for lighting, and from 4d. to 4½d. per kWh for power. It has also been decided to let out for hire electrical fittings and appliances.

Eccles.—Loan.—The Town Council has applied to the Electricity Commissioners for sanction to a loan of £7,000 for transforming and converting plant with a view to utilising the present 3-phase bulk supply, taken from the Lancashire Electric Power Co. during such hours as the Council's station is shut down.

Irish Free State.—Cobh (Queenstown).—At a recent meeting of the Urban Council, the town clerk stated that he had received estimates from the local gas company for the public lighting of the town, and also from the local electric lighting company. There appeared to be no reduction made by the gas company and very little by the electric lighting company. The Council considered that, as the cost of coal had decreased, both companies should be waited on by the Council before coming to an agreement with them for the lighting of the town for the ensuing year.

Liffey Power Scheme.—A company has recently been formed, under the title of the Anna Liffey Power Development Co., Ltd., to supply power for industrial and lighting purposes. It is proposed that the Free State Government should guarantee the finance and take over the working of the undertaking when completed, either for itself or in collaboration with the Corporation of the City of Dublin. The promoters, however, are willing to undertake the entire scheme themselves, and are seeking for the grant of a licence under Article 11 of the Constitution. The intention is to proceed by way of a private Bill, which will be lodged almost immediately.

Keighley.—Loan.—The Electricity Committee has recommended the Town Council to apply for sanction to borrow £40,000 to cover expenditure already incurred and estimated to be required during the next two years in connection with mains and services.

Leicester.—Year's Working.—The accounts of the City electricity undertaking (engineer, Mr. T. R. Smith) for the year ended December 31st last show very satisfactory results. The total revenue, from the sale of 30,714,281 kWh, and rents, amounted to £293,402, an increase of £32,593, while the working expenses totalled £167,792, as against £193,048. Of the gross surplus of £123,610, interest, income tax, &c., absorbed £45,872, sub-station plant took £7,110, and sinking fund £20,118, leaving a net amount carried to the balance-sheet of £50,510. The capital expenditure was increased to £1,191,659 by the purchase of machinery, acquisition of land, erection of buildings, &c., to a total amount of £337,538. The amount applied to debt cancellation, with last year's contribution, now amounts to £300,700, and the reserve fund has a balance of £48,473.

London. — St. Marylebone. — *Loan Sanctioned.* — The Finance Committee reports the receipt of a communication from the Electricity Commissioners sanctioning the borrowing of £195,500 for the provision of [illegible] plant and a cooling tower at the electricity works. This is on account of a sum of £292,867, for which sanction to borrow has been sought. The Commissioners do not approve the suspension of the sinking fund payments for two years, while the plant is being erected, as they cannot agree that the immediate assumption of the loan charges will be a burden on the undertaking. The Finance Committee, however, recommends a further application with regard to this matter.

Lowestoft.—Loan.—The Town Council is applying to the Electricity Commissioners for sanction to the borrowing of £3,500 for extensions to feeder cables. Application is also being made for authority to increase the maximum charge for electricity to 10d. per kWh.

Manchester.—Hire of Cookers.—The Electricity Committee proposes to let electric cookers out on hire to consumers at a quarterly charge of 12s. 6d.

Mansfield.—Extension of Supply.—The Town Council has decided to apply for authority to supply electricity to the neighbouring districts of Sutton-in-Ashfield, Kirkby-in-Ashby, Huthwaite, and Skegby. It has also decided to oppose the application of the Derbyshire and Nottinghamshire Electric Power Co. with regard to the Sutton-in-Ashfield and District Special Order.

Melton Mowbray.—Electricity Charges.—The Urban District Council has applied to the Ministry of Transport for a revision of the Melton Electric Light Co.'s charges from September 15th next.

New Zealand.—Hutt Valley.—According to a report by H.M. Trade Commissioner at Wellington, the proposal of the Hutt Valley Electric Power Board to raise a loan of £200,000 for the installation of electricity in the Hutt Valley district was carried by a large majority at a recent poll of ratepayers in the district. Power to an ultimate capacity of 2,000 kVA is to be supplied from the hydro-electric station at Mangahao.

Northwich.—Electricity Supply.—The Urban District Council has applied to the Northwich Electric Supply Co. for terms on which it would be prepared to give a supply of electricity for lighting in certain portions of the Council's area.

Price Reductions.—Islington.—The 100 per cent. increase on pre-war charges has been reduced to 50 per cent., representing an annual amount of £51,000.

Darlington.—Power: maximum demand rate, £3 per annum per kW and ⅜d. per kWh; restricted-hour maximum demand rate, £2 per annum per kW and ⅜d. per kWh; sliding scale rate, first 500 kWh 1½d. per kWh, next 500 kWh, 1¼d. per kWh, next 2,000 kWh 1¼d. per kWh, and all energy in excess of this amount ¾d. per kWh.

High Wycombe.—Power: first 100 kWh 6d. per kWh, next 3,000 3½d. per kWh. All energy above this amount 2d. per kWh.

Llandilo.—Lighting, a reduction of 2d. per kWh; power, a reduction of 1d. per kWh.

Salford.—Heating and power from 65 per cent. to 50 per cent. above the pre-war rate.

Southport.—Lighting: from 7d. to 6½d. per kWh; lighting business premises, maximum demand, from 8d., 6d., and 4d. to 8d., 5d., and 2d. Domestic power and heating: flat rate 2d. per kWh, with 1½d. per kWh for each summer quarter and 1¾d. per kWh for the winter quarters. Industrial power: flat rate of 2d. Long-period consumers will have the alternative of a maximum demand tariff on the basis of £8 per kVA of maximum demand per annum, plus ¾d. per kWh, the charge not to exceed 2d. per kWh.

Tredegar.—Electricity in Bulk.—As the outcome of a deputation of tradesmen, who desire a supply of electricity, the Urban Council has decided to ask the South Wales Electrical Power Distribution Co. for its terms for a supply in bulk.

Wakefield.—Loan.—The Town Council is applying to the Electricity Commissioners for sanction to the borrowing of £5,000 to meet the cost of consumers' services and cut-outs provided during the financial year 1922-23, and the provision of future services and cut-outs.

Warrington.—New Plant.—A new Brush-Ljungström turbine, of 6,000-kW capacity, has been put into commission at the electricity works.

Watford.—Loan Sanctioned.—The Town Council has received sanction to a loan of £25,000 for electricity purposes. The total applied for was £39,000 and the Commissioners have intimated that they will be prepared to consider sanctioning the borrowing of any further sum required when the actual total expenditure has been approximately ascertained and details have been furnished.

TRAMWAY AND RAILWAY NOTES.

Argentina.—Buenos Aires.—A further development is reported in connection with the proposed revision of the fares charged by the Anglo-Argentine Tramways Co., mentioned in our last issue. The company has expressed its willingness to undertake the construction of a subway at a cost of about five millions sterling, but states that unless it is permitted to charge a 15-cent fare it will be unable to undertake the work, which is of great public utility. It is thought that the reason why the municipality desires to reduce the present fare from 12 to 10 cents is to enable it to take the latter figure as a basis upon which to place the 3-cent increase now suggested by the company.

Australia.—Adelaide.—The 32nd half-yearly statement of accounts of the Adelaide Tramway Trust shows a total revenue of £303,624. Working costs amounted to £211,614, leaving a gross profit of £92,010. Interest, &c., absorbed £73,791 and £12,079 has been placed to reserve for renewals, leaving a net surplus of £27,179, making the accumulated surplus to date £33,320. Extensions are being carried out at the Port Adelaide power station, a 6,000-kW turbine being in course of erection and the transmission pressure is being increased from 11,000 V to 33,000 V. Fifty new cars are on order and extensions are being carried out on various routes.

Bolton.—Track Renewals.—The borough engineer (Mr. E. Ll. Morgan) has been instructed to obtain tenders for special track work required for the Town Council.

Bradford.—Railless Car Scheme Abandoned.—Following on the abandonment of parts of the proposed extensive scheme of railless trolley vehicle services between the city and the areas of various surrounding district councils, the City Council last week abandoned the proposed railless car scheme to Shipley and Bailden.

Continental.—Spain.—Application has been made by Don Angel Vila Periquet for a concession to construct an electric tramway from Lerida to Pont de Suert.

The Sociedad de Tranvais Electricos de Granada has completed a further section of its line to the port of Motril. The total length of line now completed is 100 km.

Sweden.—Three of the leading directors of the State Railways have returned from Switzerland, where they have been engaged in the study of the electrification of railways. In an interview the directors said that they expected it would be possible to begin the electrification of the line between Gothenburg and Stockholm in two or three months' time. The work, they estimated, would be completed in two years. The Riksdag made a grant of funds for this purpose some time ago.—*Reuter's Trade Service* (Stockholm).

Germany.—It is reported from Essen that the occupying authorities of the Ruhr have issued an order requiring the tramways to pay over to the former 10 per cent. of the receipts. The owners have replied that the tramways will be brought to a standstill if the demand is persisted in.

Darlington.—Track Improvements.—With a view to improving the tram service from the Market Place to Cockerton the Corporation has decided to extend the loops, enabling it to run a ten-minutes' service.

Glasgow.—Inquiry.—The Ministry of Transport held an inquiry on April 10th into the application of the Corporation for a Provisional Order to purchase the Paisley tramways and the subway railway, and to construct certain new tramways. Mr. H. P. Macmillan, K.C., for Glasgow, dealing with the section of the Order relating to the Paisley tramways, stated that the proposal was that the company should sell its undertaking to the Glasgow Corporation for £250,000, as from July 1st, 1922. The system radiated from the centre of Paisley to Renfrew, Spiers Bridge, Thornliebank, and to Johnstone and Milbarchan. The cost of the undertaking was £431,309. The Town Clerk for Renfrew, who opposed the application, stated that the scheme included the widening of the High Street of Renfrew, which would involve an expenditure of £33,000, towards which sum the Glasgow Corporation had offered £1,000 and the Renfrew Council considered the offer inadequate. The Ministry of Transport intimated that the preamble of this section of the Order was proved and expressed an opinion that the Glasgow Corporation should make an appropriate contribution to the cost of widening the High Street.

In connection with the subway railway Mr. Macmillan stated that the Corporation intended to incorporate the subway in its tramway undertaking and have it electrified. The Ministry of Transport found the preamble proved as regarded the taking over of the subway on the footing of a tramway and not a railway.

Huddersfield. — Accident. — An overhead wire fell in Quarmby Road on April 13th and held up the tramway service for three-quarters of an hour.

London.—Tramcar Fire.—A fire broke out on a tramcar at Tooting Junction on Sunday evening last and the Mitcham fire brigade was summoned. There was no injury to passengers.

Newcastle-on-Tyne.—New Cars.—At a meeting of the City Council, on April 11th, on the recommendation of the Transport and Electricity Committee, it was decided to purchase 25 additional cars and accessories, at a cost of £2,000 each. Application will be made for sanction to borrow the necessary £50,000.

Road Transport.—Trade Union Proposals.—Col. Wilfrid Ashley, Parliamentary Secretary to the Ministry of Transport, received a deputation from the Transport and General Workers' Union last week on matters affecting road transport. *The Times* states that the deputation was introduced by Mr. Ben Tillett, M.P., who said that they wished to cover the whole field of road transport as it affected both commercial vehicles and passenger vehicles, and said it was the duty of the State to ensure that the public would get proper facilities. He urged that there should be set up a varied representation of all parties in order to view the question as a whole, and so direct affairs.

Mr. J. Cliff (national secretary of the Road Transport Passenger Section of the union) dealt with the overloading of tramway cars and omnibuses, and expressed the desire of the men that the passengers per vehicle should be limited to the number for which the vehicle was licensed. Competition amongst the services led to dangerous driving, and he claimed that there should be some Government authority in order to regulate traffic.

Mr. A. Smith (a member of the Committee of the Ministry of Transport which dealt with Metropolitan traffic) claimed that overcrowding of London omnibuses and tramway cars should be a matter for that Committee to determine. The provinces usually followed whatever was done in London.

Mr. Ben Tillett emphasised the chaotic condition of the Acts of Parliament affecting road transport. Road transport workers were still without any Acts protecting their interests.

Col. Ashley said that he would consider the points which has been raised.—*The Times.*

Wolverhampton.—Railless Cars.—In connection with our note in last week's issue the Town Council has confirmed the Tramways Committee's proposal to reconstruct the track on Wednesfield Road route and to substitute railless cars for the tramway system, at an estimated cost of £15,328, £5,000 of which is to be met out of revenue and the remainder by means of a loan. Arrangements have been concluded with the Heath Town Council and the Wednesfield District Council, and the service will be extended into Wednesfield.

Wath-on-Dearne.—Light Railways.—The Urban Council has been notified that it is intended to commence the construction of the Dearne district light railways at an early date.

TELEGRAPH & TELEPHONE NOTES.

British Cochin.—Telephone Service.—Good progress has been made in the introduction of the telephone service in Cochin. Under the supervision of Mr. R. W. Matthews, Deputy Assistant Engineer, Telegraphs, from Trichinopoly, mains have been laid both in British Cochin and in Mattancherry and the service will be started shortly. The exchange will be located in the Telegraph Office, most of the subscribers being representatives of the mercantile community. The maximum number of connections now provided for is 100.—*Indian Engineering.*

India.—Karachi Telephone Service.—The Bombay Telephone Co. has asked for the consent of the Karachi Municipality to the assignment of the company's business to a new company, which it is proposed to form for the purpose. The Municipality has appointed a committee to consider the transfer.—*Indian Engineering.*

Manchuria.—Automatic Telephones.—The telephone service in Dairen, Manchuria, was switched over on March 31st to a new automatic plant of 5,200 lines. The value of the equipment supplied is well over 1,500,000 yen (equal to about £160,000). The contract for the installation was negotiated with the Japanese Government, acting on behalf of the Kwantung Government.—*Financial Times.*

The official opening of the Strowger exchange at Dairen marks the second stage in automatic telephone development in the Far East, the important railway centre of Harbin being already equipped with a Strowger system, which was put into service in 1921, and serves 3,000 subscribers. The new Dairen installation at present serves 5,200 subscribers, and like that installed at Harbin, was manufactured and installed by a British firm, the Automatic Telephone Manufacturing Co., Ltd., Liverpool, which secured both contracts in the face of foreign competition. This firm has supplied some sixteen public and private automatic exchanges to the Far East, including a 400-line equipment to the G.P.O., Tokio. In the United Kingdom the system is being introduced into many provincial cities, and it will be remembered that this firm has recently secured the contract for 11,000 automatic lines for Bombay, and this equipment is now being installed.

Transatlantic Cables.—Rate Reduction.—Reduced rates for transatlantic telegrams are announced by the Western Union Telegraph Co. to come into force to-day (April 20th).—*Daily Mail.*

RADIO-TELEGRAPHY AND TELEPHONY.

Broadcasting.—New Licence.—It is reported that, although the British Broadcasting Co., Ltd., has reached no final agreement with the Postmaster-General upon the subject of the new constructor's licence that it is proposed to issue to makers of home-made receiving sets, the company has offered to accept the P.M.G.'s proposal for the issue of such a licence at 10s. (half of which will go to the B.B.C.) provided that the conditions be otherwise consistent with the terms of the agreement between the company and the P.O. authorities. One provision which the company regards as of great importance is that all components used in the construction of

amateur sets shall be of British manufacture. The B.B.C. does not feel that the protection which was promised it has been given, and further proposals are being considered.

France.—Broadcasting.—Radio-telephony is increasing daily in popularity; aerials have everywhere sprung up in suburban gardens, and Parisians are adopting many and varied devices which enable them to receive concerts with crystal apparatus, without incurring the protests of their neighbours or of their landlord, by the use of antennæ. Among the favourite methods of dispensing with an aerial is the use of a large reel of wire, wound between two hoops, and hung on the wall or outside a window, and also the use of apparatus which makes use of the wire of the electric light system. Experiments have been carried out on board the Seine river boats fitted with receivers, and if the innovation is definitely adopted a slight increase in fares will probably be made.—*Reuter* (Paris).

India.—New Radio Station.—Before his departure from Gwalior at the conclusion of his visit to the Maharaja Scindia of Gwalior, the Viceroy of India (Lord Reading) opened the new radio installation there and dispatched the first message from it.—*Reuter* (Simla).

Norway.—Broadcasting.—The first Norwegian radio concert was to be broadcast from the Christiania radio station on the evening of April 12th at 10 o'clock (Norwegian time), equivalent to 9 o'clock Greenwich mean time.—*Reuter* (Christiania).

Russia.—Ships' Radio Stations.—The Baltic State Navigation Undertaking has placed orders with the radio department of the Weak-Current Trust for the supply of radio installations for 20 ships. At the same time the National Commissariat of Communications has given orders to the Trust to construct 25 receiving stations and 9 receiving-transmission stations in the vicinity of Lake Onega, in Tuapse, and other points in the Crimea and the Caucasus.

South America.—New Radio Service.—A new commercial radio service between Great Britain and the South American Republic of Colombia was inaugurated on April 12th. The service is the outcome of efforts made by the Colombian Government since the war to improve communications within Colombia itself and with the outside world. The principal station is situated at Bogota, the capital.—*Daily Telegraph.*

CONTRACTS OPEN AND CLOSED

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Amble.—May 1st.—Urban District Council. Pole line, transformers and switchgear. (April 13th.)

Australia.—Melbourne.—August 31st. Victorian Electricity Commission. 500 miles of .0707 sq. in. aluminium steel-cored cable.—*Reuter's Trade Service.*

July 31st. Electricity Commissioners. Electrically-operated power shovel. (See this issue.)

Brisbane.—June 5th. Public Works Department. Three motor-driven pumps.—*Reuter's Trade Service* (Melbourne).

Argentina.—Buenos Aires.—June 4th. Department of Navigation and Ports. Machine tools, electric motors, pumps, electric battery trucks, ceiling, wall, and table fans.*

Belfast.—May 7th. Electricity Department. One 1,000-kW and one 1,500-kW rotary converters, with transformers, switchgears, &c. (See this issue.)

Belgium.—The municipal authorities of Bourg-Leopold (Province of Limbourg). Establishment of an electricity distribution system in the town.

The Belgian State Railway authorities are at present installing electric lighting at many of the railway stations on the system; tenders have been invited for the carrying out of such installations at the stations of Florennes-Central, Florennes-Est, Hanzinne, Opwyck, and Ligny-Sud.

April 25th. The Belgian Post and Telegraph authorities at La Salle Madeleine, Brussels, are inviting tenders until April 25th for the supply of 32 lots of miscellaneous telegraph and telephone apparatus.

May 3rd. Municipal authorities of Schaerbeek, Brussels. 7,000 metres of l.p. armoured cable. Particulars from the Service Electrique, Hotel Communale, Schaerbeek.

Carlisle.—April 23rd. Electricity Department. H.p. and l.p. paper-insulated lead-covered cables. (April 6th.)

April 25th. Electricity Department. One water-tube boiler. (April 13th.)

Cupar (Fife).—April 21st. Fife and Kinross Joint Sanatorium Board. Electrical plant and equipment, accumulators, and X-ray apparatus. J. M. Mitchell, joint clerk, County Buildings, Cupar.

Dublin.—April 30th. Electricity and Public Lighting Committee. Single-phase and three-phase meters and slot meters for one year. Town Clerk (John J. Murphy), Fleet Street offices, Dublin.

April 21st. St. Joseph Deaf and Dumb Institution of Cabra, Dublin. Overhead service lines and internal wiring and fittings. Tenders received up to noon to-morrow (Saturday). Mr. J. Healy, secretary, 12, North Great George's Street, Dublin.

Edinburgh.—April 23rd. Electricity Supply Department. One 250-kVA, 3-phase transformer and 6,600-V switchgear. (April 13th.)

April 26th. Electricity Department. E.h.p. underground cables. (See this issue.)

France.—Paris.—May 8th. Administration des Posts et Télégraphes. Multiple switchboard at Perpignan office. Particulars from Direction de l'Exploitation Téléphonique, 4e Bureau, 103, Rue de Grenelle, Paris.

Glasgow.—April 30th. Electricity Department. Cables, meters and carbons for 12 months. (April 13th.)

Grimsby.—April 28th. Electricity Department. Substation 6,000/6,600-V switchgear and five transformers, with capacities up to 100 kVA. (April 13th.)

Halifax.—April 23rd. Electricity Committee. Steelwork required in new boiler foundations and reconstruction of battery-room floor at electricity works. Borough engineer, Crossley Street, Halifax.

Harrogate.—April 30th. Electricity Department. H.p. or e.h.p. switchboard for single-phase a.c. (See this issue.)

Hull.—City and County Telephone Committee. Table telephone instruments, rubber-covered wire, and dry cells. (April 13th.)

Ilford.—May 8th. Electricity Works. 500-kW converting plant. (See this issue.)

Kirkcaldy.—May 1st. Electricity Works. H. and l.p. feeder cables and cooling tower. (April 13th.)

London.—Metropolitan Asylums Board.—April 25th. Electric lighting installation in the staff blocks, &c., at the Grove Fever Hospital, Tooting, S.W. (April 13th.)

Lytham-St. Annes.—April 26th. Electricity Department. E.h.p. cables. (April 13th.)

Manchester.—May 4th. Electricity Department. L.p. pipework, &c. (See this issue.)

Mountain Ash.—April 23rd. Electricity Department. Two 300-kW, 3-phase transformers. (See this issue.)

New Zealand.—Wellington.—May 22nd. Post and Telegraph Department. Wall and desk C.B. telephones.*

June 12th. Public Works Department. Electric storage battery and accessories.*

Napier.—Borough Council. One 500-kVA generator and exciter set. Hay, Vickerman & Lancaster, Ltd., Wellington, N.Z.*

Preston.—Electricity Committee. Two 500-kW rotary converters, with transformers and switchgear. E.h.p. and l.p. paper-insulated cable Borough electrical engineer, 118, Fishergate, Preston.

Reigate.—April 30th. Electricity Department. Transformers and switchgear. (April 13th.)

Rochdale.—April 23rd. Board of Guardians. Electric lighting and telephone installation at the Union offices. Mr. R. A. Leach, Union Clerk, Union Offices, Townhead, Rochdale.

Southampton.—April 30th. Electricity Department. E.h.p. cables and switchgear. (See this issue.)

Spain.—The Municipal authorities of Utiel (Province of Valencia) are inviting tenders for the concession for the electric lighting of the town.

Southport.—April 24th. Town Council. Relaying 1,738 yd. of single tramway track in Mornington Road, Derby Road, and Sussex Road. Mr. A. E. Jackson, borough engineer, Town Hall, Southport.

Stoke-on-Trent.—May 16th. Electricity Department. One 5,000-kW turbo-alternator and condensing plant. (April 6th.)

Sweden.—Norrkoping.—Harbour Board. Three 4-ton and one 5 to 6-ton electric cranes. Particulars from the British Vice-Consul, Norrköping.*

Taunton.—April 26th. Electricity Department. One water-tube boiler. (April 13th.)

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

CLOSED.

Australia.—Sydney.—Consequent upon the City Council's adoption of a policy of absolute Empire preference, the Electricity Committee has recommended the rejection of a Japanese tender of £687 for the supply of 2,500 disk strain insulators in favour of a Canadian tender of £1,562.—*Reuter's Trade Service* (Sydney, N.S.W.)

Belgium.—Five concerns—three Belgian, one French, and one British (Callender's Cable Co., London)—submitted tenders last week to the municipal authorities of Schaerbeek, Brussels, for 2,750 metres of armoured cable and 1,375 metres of two-conductor telephone cable; the lowest offer was that of Kamps & Cie., Brussels.

Seven concerns—four Belgian and one each Dutch, British, and French—submitted tenders at the end of March to the municipal authorities of Saint Gilles, Brussels, for the supply of 19,050 metres of continuous-current armoured cable to work at a pressure of less than 750 volts, and 9,550 kg. of bare copper cable. The lowest tender was submitted by the British Insulated and Helsby Cables, Ltd., of Prescot, the next lowest offer being that of the Nederlandsche Kabelfabriek, of Delft, Holland. We have not so far been able to ascertain whether the order has been placed in this country or whether it has gone to the Dutch Co.

Bolton.—Electricity Committee. Accepted:—

Supply of 3-phase transformers required during the next 12 months.—Brush Electrical Engineering Co., Ltd.

Tramways Committee. Accepted:—

Special track work for Breightmat Street and Shifnall Street entrances of central car shed.—Hadfields, Ltd., Sheffield

The Corporation has placed a contract with the Cargo Fleet Iron Co. for the supply of steel tram rails and fishplates.

Cuba.—The Westinghouse Electric International Co. has received an order for 1,125 meters of different sizes, which will be utilised in the change from direct to alternating current in the system of the Cardenas Electric Light and Power Co.

Folkestone.—Town Council. Accepted:—

Electric lamp columns (£36 17s. 6d. each).—Walter Macfarlane & Co.

Glasgow.—Tramways Committee. Recommended:—

Relays.—General Electric Co., Ltd.
Switches and fuse bridges for sub-stations.—Simplex Conduits, Ltd.; and General Electric Co., Ltd.
Lead-covered cable.—Siemens Bros. & Co., Ltd.; and Western Electric Co., Ltd.

Watching and Lighting Committee. Accepted:—

Supply of poles and extension pieces for the electric lighting of streets.—Stewarts & Lloyds, Ltd.

Glossop.—Town Council. Accepted:—

Installing electric light at the swimming baths.—Urban Electric Supply Co., Ltd.

London.—St. Marylebone.—The Electricity Supply Committee recommends that £3,400 be paid to the General Electric Co., Ltd. (proprietors of Fraser & Chalmers), in settlement for extras in connection with the contract dated November 4th, 1920, for an 8,000-kW turbo-alternator and condenser equipment, subject to the provision by the company of improved-type switchgear for the auxiliary motors and a collar-type thrust bearing on the turbine free of cost.

The Electricity Committee, reporting on the pneumatic coal-handling plant supplied by H. J. King & Co., Ltd., at £4,500, on which £1,606 has been paid, states that the maximum discharge of fuel by the plant is far short of requirements and the undertaking of 40 tons per hour given in Messrs. King's contract; that the choking of pipe lines is frequent, the fuel becomes powdered, defeating the objects for which higher prices are paid for the better-class fuels, and altogether the plant, as laid out, is an admitted failure; also, it appears doubtful if the plant could be made to work satisfactorily without completely re-arranging the lay-out, incurring heavy expenditure and departing from the original proposals on which this type of plant was selected. After careful consideration the Committee is of opinion that the rejection of Messrs. King's plant and the purchase of a suitable crane is the most practicable solution to the present situation, and recommends: That the plant be rejected, and that Messrs. H. J. H. King and Co. refund the £1,500 expended by the Council on terms as arranged, the complete plant to be held as security until payments are made, and that the steelwork erected by Messrs. King for bunkers, valued at £106, be retained.

The Committee has considered the Council's resolution referring back the recommendation that the tender of the British Insulated & Helsby Cables, Ltd., be accepted for the ensuing year, and are making inquiries as to the experience of other undertakings with the firms who submitted lower tenders, and will report thereon at the Council's next meeting.

Manchester.—Tramways Committee. Accepted:—

Two "light-weight" tramcar motors.—British Thomson-Houston Co., Ltd.
Steel rails.—Cargo Fleet, Ltd.

General stores for 12 months:—

Commutator segments.—P. R. Jackson & Co., Ltd.; Manchester Armature Repair Co., Ltd.; Metropolitan-Vickers Electrical Co., Ltd.
Armature coils.—P. R. Jackson & Co., Ltd.; Manchester Armature Repair Co., Ltd.
Magnet coils.—P. R. Jackson & Co., Ltd.
Incandescent lamps.—R. O'Brien & Co.; Drake & Gorham (Wholesale), Ltd.
Phosphor bronze springs and controller fingers.—Fairless Engineering Supplies Co., Ltd.
Insulating material, &c.—L. Andrew & Co.; R. Whiffen, Ltd.; Connollys (Blackley), Ltd.; Griffiths Bros. & Co. (London), Ltd.
Car-lighting switches, fuses, dry cells, &c.—General Electric Co., Ltd.
Tumbler switches and lampholders.—Edison Swan Electric Co., Ltd.
Electric bells and parts.—Mason & Brown.
Carbon brushes, Chatterton compound, &c.—Hamnett & Andrew.
Overhead equipment, material, &c.—A. Wiseman, Ltd.
Trolley poles.—Equipment & Engineering Co., Ltd.
Grid resistances.—Electro-Mechanical Brake Co., Ltd.; H. Wallwork and Co., Ltd.
Power and lighting cable.—Enfield Ediswan Cable Works, Ltd.
Copper wire and strip.—F. Smith & Co., Ltd.
Galvanised steel cable.—R. Johnson & Nephew, Ltd.

Rivers Committee.

Electrification of the Davyhulme sewage works.—Metropolitan-Vickers Electrical Co., Ltd.

Newcastle-on-Tyne.—City Council. Accepted:—

Tramway rails and fishplates (£13,611).—Bolckow, Vaughan & Co.

Rotherham.—Town Council. Accepted:—

300 tons of tram rails (£14 per ton).—Steel, Peech & Tozer, Ltd.

Sheffield.—Corporation. Messrs. Richard Garrett & Sons, Ltd., have received from the Cleansing and Baths Department an order for ten 5-ton electric vehicles to be equipped for the collection of refuse. This is the second repeat order for 10 vehicles which they have received from the same source. Including these, the fleet of electric vehicles in use at Sheffield for cleansing purposes will number 64. Messrs. Garrett have about 50 electric vehicles, of from 1¼ to 6 tons capacity, under construction at the present time.

St. Helens.—Tramways Committee. Recommended:—

Reconstruction of the tramway track from the borough boundary at Eccleston Hill to Higher Parr Street, *via* Prescot Road, Westfield Street, Liverpool Road, and Church Street.—T. Coates, Bacup.
Special track work in connection with the relaying of the track.—Edgar Allen & Co., Ltd., and Titan Trackwork Co., Ltd.

FORTHCOMING EVENTS.

Electrical Trades Benevolent Institution.—Monday, April 23rd. At the Institution of Electrical Engineers, Victoria Embankment. At 2.30 p.m. Annual meeting.

Royal Society of Arts.—Monday, April 23rd. At John Street, Adelphi, W.C. At 8 p.m. Cantor lecture, "Nitrates from the Air," by Mr. E. Kilburn Scott (Lecture III).

Illuminating Engineering Society.—Tuesday, April 24th. At the Royal Society of Arts, John Street, Adelphi, W.C. At 8 p.m. Discussion on "Some Problems in the Lighting of Printing Works," to be opened by Mr. L. Gaster.

Electrical Contractors' Association.—Tuesday, April 24th. At the Café Monico, Piccadilly, W. At 6.30 for 7 p.m. Annual dinner.

Liverpool Engineering Society.—Wednesday, April 25th. At the Royal Institution, Colquitt Street. At 8 p.m. Annual general meeting.

Royal Institution of Great Britain.—Thursday, April 26th. At Albemarle Street, W. At 3 p.m. Lecture on Modern Electric Lamps. (1) "Glowing Solids in Vacuo (Tungsten Lamps)," by Prof. J. T. Macgregor-Morris.

Institution of Electrical Engineers.—Thursday, April 26th. At the Institution, Victoria Embankment, W.C. At 6 p.m. Paper on "The Drive of Power Station Auxiliaries," by Mr. L. Breach and Mr. H. Midgley.

(Informal Meeting).—Monday, April 23rd. At the Institution. At 7 p.m. Discussion on "Practical Broadcasting," to be opened by Mr. E. H. Shaughnessy.

(Scottish Centre).—Friday, April 27th. At the Technical Institute, Dundee. At 7.30 p.m. Paper on "The Drive of Power Station Auxiliaries," by Messrs. L. Breach and H. Midgley.

(South-Midland Centre).—Wednesday, April 25th. At the University, Birmingham. At 7 p.m. Ordinary meeting.

Students' Section.—Friday, April 27th. Annual general meeting. Paper on "Mining Switchgear," by Mr. F. H. Bacon.

Junior Institution of Engineers.—Friday, April 27th. At 39, Victoria Street, S.W. At 7.30 p.m. Lecturette, "Stock Control," by Mr. J. Fearn.

Physical Society of London.—Friday, April 27th. At the Imperial College of Science, South Kensington, S.W. At 5 p.m. Ordinary scientific meeting.

Institution of Production Engineers.—Friday, April 27th. At the Engineers' Club, W. At 7.30 p.m. Paper on "The Efficient Tooling of Automatics," by Mr. L. C. Keen.

THE "ELECTRICAL REVIEW" SERVICE DEPARTMENT.

We have to remind readers that Service Department inquiries should be accompanied by a stamped envelope.

The makers or suppliers of the following devices are asked for:—

Lavite fire-resisting cement.

Small motors for normal supply voltages (16 to 60 watts—2,500 to 1,400 r.p.m.).

Chameleon lamps.

NOTES.

S.E. Lancs. Electricity Advisory Board.—The Board has drawn up a form showing the information required from authorities in its area who propose to erect new stations. Details of the existing plant are required, with plans showing coaling and water facilities, &c. Estimates of the cost, entered under thirteen heads, are also asked for, as well as a statement as to the area in which a supply is to be given from the new station.

"Moving Platform" Scheme for Paris.—No decision has yet been taken with regard to the scheme for endowing Paris with an underground "moving platform," which would somewhat relieve the overcrowded underground railways. The technical sub-commission charged with the examination of the plan is now studying a report drawn up by the chief engineer of the Metropolitain underground railway, which severely criticises the thirteen plans which have been retained by the sub-commission for consideration. Such Anglo-Saxon names as Lewis, Halter and Putnam appear on the list of competitors who have submitted plans.—*Reuter* (Paris).

Lecture.—At the Birmingham and District Electric Club on April 14th, Mr. E. Cauldwell, A.M.I.A.E., gave a lecture on "The Engine of the Small Generating Set," in which he analysed the problem presented to the designer of the internal-combustion engine, using the Otto cycle and suitable for driving generators up to 6 kW. The lecturer especially dealt with engine efficiency as conditioned by mechanical design, engine speed, and fuel properties. The difficulties of obtaining ideal efficiencies were dealt with at length. The paper was highly technical and gave much evidence of individual research. It was illustrated with a large number of graphs and included many formulæ.

Educational.—Faraday House Entrance Scholarships.—As a result of the entrance scholarship examination held at Faraday House Electrical Engineering College on April 10th, 11th, and 12th, the following awards have been made:—

B. K. Watts, Aldenham School, Elstree, the "Faraday" Scholarship of 50 guineas per annum, tenable for two years in college and one year in works.

J. B. Browning, St. George's School, Harpenden, the "Maxwell" Scholarship of 50 guineas per annum, tenable for one year in College and one year in works.

S. Anderson, Bedford School, an exhibition of 30 guineas per annum, tenable for two years.

L. B. Law, the Grammar School, Shaftesbury, an exhibition of 20 guineas per annum, tenable for two years.

J. Chavooshian, private study, an entrance prize of 20 guineas.

The Specific Heat of Gases at High Temperatures.—Apart from its theoretical interest, a knowledge of the specific heat of gases at high temperatures is of considerable importance to the engineer concerned with internal combustion engines and to the metallurgist, but its actual measurement is fraught with many practical difficulties. We therefore welcome the new method devised by Prof. J. R. Partington and Mr. W. J. Shilling, and described by them at the January meeting of the Faraday Society, which appears to promise a high degree of accuracy.

The method consists of measuring the velocity of sound in a large silica tube (1 m. long by 4 cm. bore) heated electrically, at intervals of about 100 deg. C., from room temperature up to 1,000 deg. C. The apparatus is shown in the

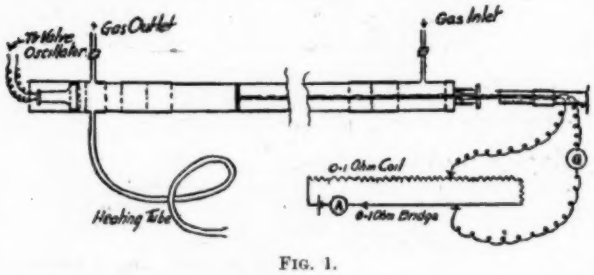


Fig. 1.

accompanying diagram, from which, however, the heating coils of nichrome wire and the slag-wool lagging are omitted. The movable piston and its rod are also made of silica, the movements of the glass guides attached to the free end of the latter being capable of measurement as indicated at the right of the diagram. The wires emerging from the rod come from a thermocouple placed at the junction of the piston rod and piston. The one wire is insulated from the other by a silica tube of 1 mm. bore. To the other end of the furnace is cemented a glass end piece which carries the gas outlet tube, the "hearing tube" and a telephone receiver, whose diaphragm closes the end of the furnace tube. This telephone forms the source of sound, and it is actuated by a valve oscillator, thus ensuring constant frequencies that can be determined by a standard wave meter. By varying the capacity of the condenser in the telephone circuit the frequency is easily varied. The apparatus is operated by passing the gas, the specific heat of which is to be measured—purified and dried—through the furnace tube and setting the telephone to vibrate. The distance of the telephone diaphragm from the side "hearing tube" is then adjusted until the best maxima are heard as the piston is moved along the tube. These positions can be determined to within 0.1 mm. and from the distance between them the velocity of sound is easily calculated, a correction being applied for the diminution in velocity due to the tube. From the velocity of sound the ratio of the specific heats of the gas is calculated and their difference being known from the gas laws their actual values are determined. The values of C_v for air for temperatures up to 700 deg. C. are given by the straight-line equation $C_v = 4.849 + 0.0036\ T$ gm. cals. Above this point the specific heat increases more rapidly with temperature, and the engineer is interested in values considerably higher, but the measurements are being repeated with a much longer tube with which it is expected to obtain accurate results at higher temperatures.

Copper Refining.—The introduction of a new alloy used for one of the electrodes in the electrolytic refining of copper has cut the cost of copper production at Chuquicamata, Chile, to only 6.4 cents per pound, according to the annual report of the Anaconda Copper Mining Co. The new alloy, consisting essentially of copper and silicon, developed by Mr. C. G. Fink, is used for the anode during copper recovery from the electrolyte and reduces current losses and contamination of the product experienced when ferrosilicon and lead electrodes are used. Figures of the Chile Copper Co. show that the cost per pound of copper, exclusive of interest, depreciation, and depletion, dropped from 10.8 cents in 1921 to an average of 6.4 cents in 1922. In 1915 the figure was 16.34 cents.—*Science.*

The F.B.I. Appeals for Reduction in Railway Rates.—The following important communication was on Tuesday addressed to the secretary of the Railway Clearing House by Sir Eric Geddes, president of the Federation of British Industries:—

Sir,

The Federation of British Industries has had under further consideration the negotiations and correspondence which have been taking place between them and the Railway Clearing House since the Federation's letter of February 7th.

The Federation heard with satisfaction that it was the general desire of the Railway Companies to make an all-round reduction in rates. They feel, however, that it is of the greatest importance to industry that this reduction should be substantial and made at the earliest possible date. Most industries, as you are aware, have already at the cost of great sacrifices achieved a reduction in costs to a level which appears likely to be the minimum for some years to come, and it only remains now for the costs over which industrial enterprises have no direct control, such as railway rates, to be similarly reduced in order to secure a position of stability which would greatly assist and accelerate the improvement in trade which has already commenced.

The traffic receipts for the first quarter of 1923 show clearly that in the three groups serving the important industrial areas of the Midlands and the North, these receipts are, with the reduced rates, steadily rising above the figures for the corresponding dates in 1922, and that the upward movement in traffic commenced immediately after the general reduction of rates and charges on August 1st last, and has continued steadily ever since. This improvement in the volume of traffic is borne out by the official ton-mile figures as far as these are available, and it seems a legitimate inference that the rate reductions made in 1922 have been largely responsible for it.

In these circumstances the Federation feel that they are justified in asking the Railway Companies to adopt of their own accord and initiative a bold and generous policy in a matter which is of such importance to the general prosperity of the community.

They desire to point out that a voluntary reduction to the lowest possible level effected at an early moment would produce a feeling of confidence in the future stability of costs and prices which would be of the greatest assistance not only to the industrial and trading community generally by stimulating business and expanding employment, but to the Railway Companies themselves, by increasing the volume of traffic.

In conclusion, the Federation desire to emphasise the importance of preserving that spirit of co-operation between the Railway Companies and railway users which has been one of the happiest results of the new relations created by the Railway Act, and to suggest that the Railway Companies have now an unparalleled opportunity to gain the confidence, co-operation and goodwill of industry and the public generally.

(Signed) Eric Geddes,
President.

April 17th, 1923.

Summer Time.—Attention is called to the fact that summer time will begin at 2 o'clock, G.M.T., on the morning of Sunday next, April 22nd.

Fatalities.—On April 13th, an inquiry into the death of Edward Philpott, a cable tester employed by the Pirelli-General Cable Works, Ltd., was held at Southampton. The firm was represented by Mr. C. E. Martin, and Mr. H. M. Swan (Divisional Electrical Inspector of Factories) was present.

Ernest Joliffe, a charge hand at the works of the company, stated that the duty of the deceased man was to prepare the ends of cable for testing. On the morning of April 11th, witness was working near the test room when he heard Philpott scream. He found deceased lying on the floor about three yards from some cables which were under test. There was a rope barrier and a red danger board at the entrance of the test room and both were in position.

Another witness gave similar evidence, and stated that the deceased should not have been in the room while testing was in progress. This witness described the precautions which were taken during testing.

Dr. A. P. Harman said that the only external marks upon the body were a bruise on the forehead and a burn on the outside of the little finger of the left hand. Death was due to the deceased having come into contact with a live wire.

The electrical engineer at the factory stated that he had frequently instructed deceased not to enter the danger area while testing was being carried out.

The jury returned a verdict that death was due to electric shock.

The *Evening News* reports that Charles Albert Lawrence, a fitter at the Hibaldston Cement Works, Brigg, was recently killed by a shock received from an electric cable lamp.

"Welding" Metal to Porcelain or Glass.—Mr. Thomas E. Murray, vice-president of the New York Edison Co., has invented a process by means of which it is claimed that metal may be "welded" to porcelain or glass.—*Reuter's Trade Service* (New York).

Standardisation of Symbols and Abbreviations.—A recent conference held in New York City under the auspices of the American Engineering Standards Committee revealed a sentiment emphatically in favour of the unification of technical and scientific abbreviations and symbols. The conference was called upon requests from the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, and the Association of Edison Illumination Companies, and after some discussion on the subject it was thought desirable to include as a part of the project the graphical symbols which are used in engineering drawings, diagrams, and the like, for representing instruments and apparatus and components of them. It was agreed that the co-operation of foreign standardising bodies should be sought in the development of the work. The work will go forward under a committee organised in accordance with the rules and procedure of the American Engineering Standards Committee.—*T. & T. Age.*

Appointments Vacant.—Cable jointer for the Perth Corporation Electricity Department; sales assistant and mains assistant for the Yorkshire Electric Power Co. (See "Official Notices" to-day.)

Miners' Lamps.—In a paper which he read on April 17th, to the members of the Manchester Geological and Mining Society on "The Davy Safety Lamp *v.* the Electric Safety Lamp," Sir Henry Hall spoke of the importance of miners having some flame by which they could test the atmosphere for indications of inflammable or noxious gases. Whether the electric lamp was a good thing was full of difficulties, and mining engineers differed widely about it. Presumably one of the purposes of the electric lamp was to give the miner a better light, but was it true, Sir Henry asked, that the miner had ever suffered from want of light for his purpose? Experiments tended, for instance, to upset the view that miner's nystagmus was due to low illumination. The widely different explanation had recently been put forward that the disease was due to the emission of volatile gases from the coal seams impregnating the atmosphere. The disease was unknown in the anthracite district of South Wales where the coal was non-volatile.—*Manchester Guardian.*

INSTITUTION NOTES.

Institute of Marine Engineers.—Sir George Goodwin (President) occupied the chair at the annual meeting on April 11th. The report for the past year was presented, showing an increase of membership from 2,629 to 2,846. The following presentations were made:—The "Denny" gold medal to Engineer Lieut.-Commander J. L. de Mesurier, for a paper on Diesel marine engines; a silver medal to Mr. H. J. Young, for the best paper by a non-member; and awards to Mr. H. W. Howey (student), for success in examinations in mechanics and electrical engineering. The President for the ensuing year is Viscount Curzon, M.P.

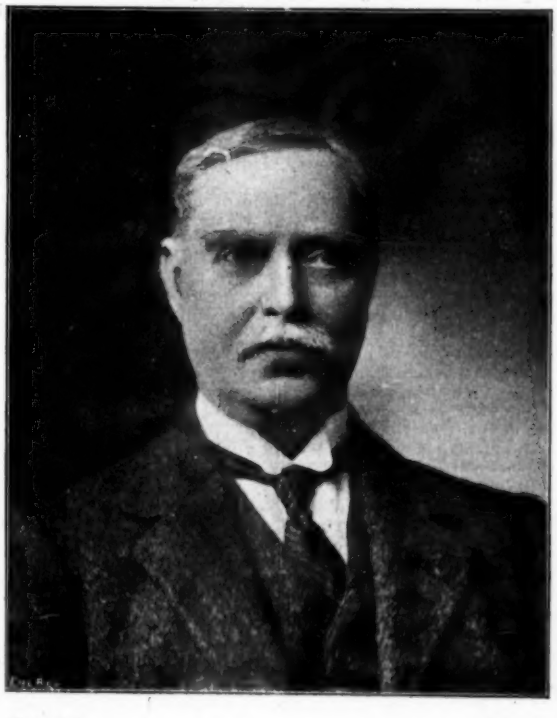
Junior Institution of Engineers.—The annual dance was held at the Cannon Street Hotel on April 6th, Mr. H. V. Pointon (Chairman of the Institution) acting as M.C.

It is proposed to hold the annual dinner at the Monico Restaurant, Piccadilly Circus, W., on May 10th. Tickets will be 10s. 6d. each.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Professor Magnus Maclean, M.A., D.Sc., LL.D., as already announced in our columns, is retiring from the Chair of Electrical Engineering at Glasgow Technical College at the end of July. He has occupied that distinguished position since 1899, and retires under the superannuation scheme. He is to be succeeded by Dr. Stanley Parker Smith, Assistant Professor in the Electrical Department, City and Guilds (Engineering) College, Imperial College of Technology. Prof. Maclean was born in Glendale, Skye, in the year 1857. From his youth he devoted himself to study and to teaching, and it was while he was working to take the M.A. degree that he won scholarships and so impressed Lord Kelvin (then Sir Wm. Thomson) that Kelvin appointed him in September, 1884—before he had finished his curriculum for his degree—as his assistant. In addition to duty performed in that capacity, Prof. Magnus Maclean taught physics for medical students for seven years, and electricity (pure and applied) for engineering students for a similar period. Lord Kelvin entrusted him with the carrying out of his important experiments and investigations in the laboratory, and they sometimes collaborated in papers. He not only took his M.A. degree with honours, but also received the degree of D.Sc., and was made a Fellow of the Royal Society of Edinburgh. In August, 1899, he was appointed Professor of Electrical Engineering in the Royal Technical College. His activities were numerous and varied. For three years from 1900, as first



Warneuke] [*Glasgow.*

Prof. Magnus Maclean, who shortly retires from the Chair of Electrical Engineering at Glasgow Technical College.

Celtic Lecturer in the University, he delivered a series of lectures on "The Literature of the Celts" and the "Literature of the Highlands." When the college removed to George Street, he took a special interest in the installation of the electric lighting and heating and in the organising of his own department. He has written many papers which have been read before the Royal Society, the Royal Society of Edinburgh, the Institution of Electrical Engineers, and the British Association. Important electrical books which bear his name include "Electricity and its Practical Applications"; "Modern Electrical Practice"; and "Modern Electrical Engineering." Last year he lectured before the I.E.E. on the hydro-electric resources of the Highlands. On February 7th, 1918, Prof. Maclean delivered the ninth Kelvin lecture before the Institution of Electrical Engineers on "Kelvin as a Teacher," a subject with which he was pre-eminently conversant, having (as his chief assistant) attended every lecture that Kelvin delivered for fifteen years; his close and continuous association with the master is, perhaps, that experience for which Prof. Maclean is most excusably to be envied.

He has acted as an examiner to the Universities, and in 1919 his own Alma Mater conferred on him the honorary degree of LL.D. It is interesting to recall that he was a member of the Moseley Education Commission to the United States in 1904. He is at present chairman of the Board of Studies in the Royal Technical College, and chairman of the Highland Trust.

We may fittingly quote here from the *Journal* of the Royal Technical College two sentences used by David Mackeggie, a fellow student, in closing a tribute to the character of the Professor and expressing the personal feelings of large numbers of those who have been brought into contact with him:—"Through his genial personality and his wide and generous sympathies and services, Professor Maclean stands high in public esteem. And as a man of the highest character and of uncommon prestige he will be greatly missed from the heart and life of the College when he retires in summer."

Captain the Right Hon. Frederick E. Guest has joined the board of the Hall Telephone Accessories, Ltd.

Mr. H. D. Lloyd recently resigned from service with the Metallic Seamless Tube Co., after two years' control of its Manchester branch and Lancashire business. His address is 87, Westminster Road, Birchfields, Birmingham. Telephone: "5232 Central."

Mr. G. C. Hadfield, for many years a member of the Sales Manager's staff of the Manchester Corporation Electricity Department, has now been appointed canvasser in the Wolverhampton Corporation Electricity Department, and on Friday last his colleagues presented him with an attaché case and a fountain pen.

Mr. H. S. Aspinall, who recently resigned his appointment as sales manager and director of the Keighley Gas & Oil Engine Co., Ltd., has been appointed general sales manager to Messrs. Vickers-Petters, Ltd., of Ipswich.

Owing to ill-health Mr. R. J. H. Ryall has resigned from the board of Todman, Ryall & Co., Ltd.

On and after 26th inst. the address of Sir Harry Renwick, K.B.E., and Lady Renwick will be Coombe Oak, Coombe Warren, Kingston Hill, Surrey.

Dr. James Robertson Riddell, who for 20 years has been in charge of the X-ray Electrical Department of Glasgow Royal Infirmary, has been appointed radiologist to the Royal Alexandra Infirmary, Paisley, where the electrical department is being extended.

Mr. Daniel Thomas, Superintendent of Telegraphs, Edinburgh, is retiring after 46 years' service.

Mr. C. Gordon Huntley, A.M.I.E.E., and Mr. William W. Wood, have entered into partnership and commenced practice as consulting engineers under the style of Huntley and Wood, at P. & O. House, Cockspur Street, London, S.W.1. They are specialising in heating, ventilating and illuminating, and ask for trade catalogues.

Freeman's Journal understands that Sir J. P. Griffith has tendered his resignation to the Government of his position as chairman of the Reconstruction Committee appointed some months ago to consider the problem of the development of Irish industries. This step, it is understood, is a consequence of his acceptance of the position of director of the Anna Liffey Development Co., which proposes to harness the Liffey for the production of electricity, electrical development being one of the subjects included in the terms of reference of the Reconstruction Committee.

The Leeds Tramways Committee has recommended that an assistant general manager and assistant traffic inspector be appointed. About two months ago Mr. J. B. Hamilton, the chief of this and other important public activities under the Corporation, asked for assistance, especially in connection with the detail work of the tramways. The matter comes before the Council shortly.

At the last meeting of the Beckenham Council, a resolution was passed thanking Mr. A. H. Dykes (of Messrs. Handcock and Dykes, consulting engineers) for the able way in which he had filled the position of chairman during the past year. Members spoke in terms of high praise and warm appreciation of his services. Mr. Dykes, in responding, said that it was now getting on for 16 years since he first became a member of the Council and seven years since he last occupied the chair.

Obituary.—Mr. C. R. Sproule.—The death of Mr. C. R. Sproule, who occupied the position of works manager at the Helsby Cable Works, on Thursday last week, came as a great surprise to Chester and Helsby people. Mr. Sproule was 48 years of age, and had been works manager of the British Insulated & Helsby Cables, Ltd., for about 15 years. He joined the firm as an apprentice in the test department at the age of 18 years. The funeral took place on Saturday.

Mr. W. Chew.—Mr. William Chew, M.I.E.E., Blackpool Corporation gas manager, who died recently, at the age of 67 years, was Blackpool's first electrical engineer, and introduced the electric arc lamps on the promenade. Subsequently he joined the gas department and succeeded his father, the late Mr. John Chew, as manager in 1913.

Wills.—Mr. W. Bates, O.B.E., M.Inst.C.E., formerly electrical engineer to the Birkenhead Corporation, left £11,531 net and £12,290 gross personalty.

The late Mr. T. W. Stratford-Andrews left £24,004 gross and £4,272 net personalty.

NEW COMPANIES REGISTERED.

"B.D.S." Wireless, Ltd. (189,035).—Private company. Registered April 6th. Capital, £1,500 in £1 shares. To carry on the business of manufacturers of wireless, telegraph, and telephone instruments, equipment and material, including crystal and valve receiving sets and parts, factors of, agents for, and dealers in electrical and other equipment and accessories, particularly relating to wireless broadcasting, receiving, and analogous instruments, &c. The subscribers (each with 250 shares) are:—D. W. A. Barton, 25, Sandon Road, Edgbaston, Birmingham, engineer; L. L. Dight, 78, Smallbrook Street, Birmingham, optician; H. R. Sharples, 16, Whitehall Road, Handsworth, electrical engineer. The first directors are to be appointed by the company. Registered office: 124, Devonshire Street, Birmingham.

Eagle Wireless Supply Co., Ltd. (189,041).—Private company. Registered April 6th. Capital, £2,000 in £1 shares. To act as selling agents for the manufactured articles of the Eagle Engineering Co., Ltd., and in particular with regard to its wireless receiving sets and component parts in connection therewith. The first directors are:—R. A. Mackenzie, 2, Cranbourne Gardens, Upminster, Essex; G. H. Champ, 123, Rugby Road, Leamington Spa; R. G. Palmer, Sherbourne Hill, Warwick (all permanent, subject to holding 50 shares each). Qualification (except permanent directors), five ordinary shares. Registered office: Eagle Works, Warwick.

Expert Electrical Co., Ltd. (189,072).—Private company. Registered April 7th. Capital, £300 in £1 shares. To carry on the business of wholesale or retail dealers in electrical articles of all kinds, &c., and to adopt an agreement with E. J. Hammond, E. H. Jackson, and E. J. Donaldson. The permanent directors are:—E. J. Hammond, 34, Leyborne Park, Kew, Surrey, electrical engineer; E. H. Jackson, 25, The Green, Richmond, Surrey, electrical engineer; E. J. Donaldson, 48, Abingdon Villas, Kensington, engineer. Registered office: 47a, Earl's Court Road, Kensington.

Newtownbutler Electric Supply Co., Ltd. (NI.75).—Private company. Registered in Belfast March 28th. Capital, £1,000 in £1 shares. To produce electricity and to carry on business as electricians, &c. The first directors are:—J. Bell, Newtownbutler, farmer; W. H. Russell, Newtownbutler, farmer and civil bill officer; F. Harte, Newtownbutler, merchant and farmer; M. G. McCormick, Newtownbutler, National school teacher; W. J. Rooney, Newtownbutler, Methodist minister. Secretary: M. G McCormick. Registered office: Crom Road, Newtownbutler, Co. Fermanagh.

Albion Rotary Engines, Ltd. (189,148).—Private company. Registered April 11th. Capital, £900 in 600 "A" shares of £1 each and 6,000 "B" shares of 1s. each. To adopt an agreement with W. J. L. Sandy, and to carry on the business of engineers, electricians, manufacturers of, and dealers in metals, tools, machines, engines or attachments, &c. The first directors are:—F. J. Turquand, 12, Belsize Park Gardens, N.W.3; W. J. L. Sandy, 246, Kennington Park Road, S.E.1, both mining electrical engineers. Secretary: F. J. Turquand. Registered office: Albion House, 59-61, New Oxford Street, W.C.1.

P. Ormiston & Sons, Ltd. (189,160).—Private company. Registered April 11th. Capital, £5,000 in £1 shares. To adopt an agreement with Dorothy F. Ormiston, and to carry on the business of wire drawers and electric wire coverers, manufacturers of, and dealers in fine wires in copper and other metals, resistance wires, fuse wires and brush wires, fine flex copper and other cords, &c. The subscribers (each with one share) are:—Mrs. Dorothy F. Ormiston, 138, Sheen Road, Richmond, Surrey; V. R. Ormiston, "Brierley," Dumsey Eyot, Shepperton, stock dealer. The first directors are:—Dorothy F. Ormiston (permanent director and chairman, subject to holding 500 shares) and others to be appointed by the subscribers. Qualification, £100. Registered office: 79, Clerkenwell Road, E.C.1.

Thomas Inventions Development Co., Ltd. (189,079).—Private company. Registered April 7th. Capital, £1,000 in £1 shares. To acquire and turn to account patent, and patent and other rights for any inventions relating to internal-combustion engines, steam engines, aeroplanes, hydroplanes, airships, motor boats, ships, and all manner of road and rail vehicles, generating plant, pumps, compressors, and electrical machines, &c. The first directors are:—J. G. P. Thomas, M.I.A.E., M.I.E.E., 11, Bedford Park Mansions, W.4; K. J. Thomson, M.I.A.E., A.M.I.E.E., 30, Pembridge Gardens, Notting Hill Gate, W.2. Secretary: K. J. Thomson. Registered office: 29, Spring Gardens, Whitehall, S.W.1.

Cheltenham Wireless Supplies, Ltd. (189,151).—Private company. Registered April 11th. Capital, £1,000 in £1 shares (200 preference and 800 ordinary). To carry on the business of electrical, mechanical and general engineers, manufacturers of, and dealers in wireless apparatus, &c. The first directors are:—L. S. Langley, 4, Park Place, Cheltenham; S. R. Neave, Whittlesey, Cambridge. Qualification, £100. Remuneration as fixed by the company. Secretary: L. S. Langley. Registered office: 4, Crescent Terrace, Cheltenham.

Wireless Apparatus, Ltd. (189,170).—Private company. Registered April 11th. Capital, £2,000 in 1,000 "A" shares of £1 and 8,000 "B" shares of 2s. 6d. each. To carry on the business of wholesale or retail sellers, installers, and suppliers of apparatus for wireless telephony and telegraphy, &c. The subscribers are:—P. Richardson, "The Gables," Shiplake, Oxon, engineer, 6,750 "B" shares; E. K. Brown, Lennox House, Norfolk Street, W.C.2, solicitor, 1 "B" share. The subscribers are to appoint the first directors. Qualification, 100 "A" shares. Solicitors, Kenneth Brown, Baker & Baker, Lennox House, Norfolk Street, Strand, W.C.2.

National Radio Corporation (189,049).—Registered on April 6th, with a nominal capital of £20,000 in 18,000 10 per cent. cumulative participating preference shares of £1 each and 40,000 ordinary shares of 1s. each. Objects:—To acquire from J. MacDougall and turn to account certain provisional protection, rights and inventions relating to or in connection with telegraphy or otherwise. The subscribers (each with one share) are:—J. MacDougall, Finsbury Court, Finsbury Pavement, E.C.2, engineer; E. J. Evershed, Thanet House, 231-2, Strand, W.C., solicitor. The first directors are:—J. MacDougall, E. J. Evershed, J. Purves, T. L. Jones, and W. J. Rand (managing director). No other address given. Qualification, £50. Remuneration, including managing director, £500 each per annum and 10 per cent. of the net profits, after 10 per cent. dividend is paid on the preference shares, divided between them. The registered office is at Thanet House, 231-2, Strand, W.C.

Anna Liffey Power Development Co., Ltd.—Registered in Dublin as a private company on April 7th, with a nominal capital of £5,000 in £1 shares. The objects are to carry on the generation and supply of electricity in all its branches. The subscribers (each with one share) are:—Sir John P. Griffith, Rathmines Castle, Rathmines, Dublin, consulting engineer and senator; Darrell Figgis, 24, Kildare Street, Dublin; Alfred D. Delap, "Priorsland," Carrickmines, Dublin, practising civil engineer; G. Marshall Harris, "Montrose," Queen's Park, Monkstown, Co. Dublin, manager and chief engineer, Dublin United Tramways Co.; John William Griffith, "Greenane," Temple Road, Rathmines, Dublin, professor of engineering, Royal College of Science. The directors are Sir John P. Griffith, Alfred D. Delap, Darrell Figgis, G. Marshall Harris, J. W. Griffith, and H. H. Jefcott. Secretary: D. Figgis. The registered office is at 115, Grafton Street, Dublin.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Kensington and Knightsbridge Electric Lighting Co., Ltd. (26,193).—Return dated March 22nd, 1923. Capital, £350,000 in £5 shares (50,000 ordinary, 10,000 first preference, and 10,000 second preference). 21,000 ordinary, 10,000 first preference, and 10,000 second preference shares taken up. £179,840 paid, being £5 per share on 15,968 ordinary and the whole of the first and second preference shares. £25,160 is considered as paid on 5,032 ordinary shares. Mortgages and charges, £140,000; guaranteed jointly by this company and the Notting Hill Electric Lighting Co., Ltd., under the powers of the Kensington and Notting Hill Electric Lighting Companies Act, 1899, £225,000.

British Power Co., Ltd.—T. W. Holland, of 9, Bedford Row, W.C.1, ceased to act as receiver for the debenture stock holders on April 3rd, 1923.

Whitstable Electric Co., Ltd.—Issue on March 10th, 1923, of £2,500 debentures, part of a series already registered.

S. G. Leech, of 11, Dacre Street, Westminster, S.W.1, ceased to act as receiver or manager on March 23rd, 1923.

Willesden Electric, Ltd.—Charge on the company's undertaking and property, present and future, including uncalled capital, dated March 29th, 1923 (supplemental to debenture dated November 16th, 1922), to secure £2,000, in addition to £4,000 secured by the debenture. Holders: Lloyds Bank.

Cambridge Electric Supply Co., Ltd.—Particulars filed of £30,000 "C" debentures, including £13,000 already registered, and premium of 2 per cent. authorised January 24th, 1923, charged on the company's undertaking and assets, present and future, the amount of the present issue being £17,000.

Issue on March 31st, 1923, of £550 debentures, part of a series already registered.

W. E. Dove & Co., Ltd. (72,630).—Return dated March 12th, 1923. Capital, £3,500 in £10 shares. 330 shares taken up. £10 per share called up on 200 shares; £2,000 paid; £1,200 considered as paid on 120 shares. Mortgages and charges, £800.

W. S. Laycock, Ltd. (68,203).—Return dated December 31st, 1922. Capital, £150,000 in 100,000 ordinary and 50,000 preference shares of £1 each. All shares taken up. £1 per share called up on 7 ordinary and 50,000 preference shares. £50,007 paid. £99,993 considered as paid on remainder. Mortgages and charges, £216,800.

Perfect Burglar Alarm Co., Ltd. (112,522).—Return dated December 31st, 1922. Capital, £4,000 in 1,000 preference and 3,000 ordinary shares of £1 each. 230 preference and 1,710 ordinary shares taken up. £1 per share called up on 1,210 and 15s. per share on 230 shares; £1,382 10s. paid; £500 considered as paid on 500 shares. Mortgages and charges, nil.

CITY NOTES.

Brush Electrical Engineering Co., Ltd.

The 34th general meeting was held on Monday, at the Holborn Restaurant, Mr. E. Garcke presiding. In proposing the adoption of the report, the chairman first referred with regret to the great loss the company had sustained by the death, at the end of last year, of Mr. Broadhurst, the managing director. Proceeding to refer to the accounts, the chairman said the gross profits of £317,000 were only about £3,000 less than the profits for the year 1921, notwithstanding the fact that the works were closed for a period of three months owing to the wages dispute in the engineering industry. The general charges were about £1,300 lower last year, and they spent about £14,000 less in maintenance, buildings and plant. The interest charges were about £2,600 less, so that the net profits, £247,837, were actually about £15,000 higher last year than for the year 1921. At the end of 1921 they carried forward £214,000 of undivided profits, subject to income tax. Of this amount they had paid during the year on account of Excess Profits Duty, Income Tax, and Corporation Profits Tax, £93,706, so that they had £120,367 to add to the net profits, making a total balance of £368,205, subject to taxes, to be dealt with. The suggestion of the directors was that of this amount £15,000 should be applied to depreciation of buildings and plant; £2,044 to further 4 per cent. interest on the prior lien debenture stock; £19,599 in writing down patents and goodwill to the nominal amount of £1; and £34,404 added to the general reserve, raising this reserve fund to £200,000. The various allocations of profits amounted to £71,048. They recommended the payment of a dividend for the past year of 10 per cent., requiring £45,856, and the carrying forward of £251,300. Dealing with the balance sheet, he said that stock of goods and materials in hand and work in progress stood at £242,000, compared with £401,000 at the end of 1921, and close on £600,000 at the end of 1920. At the end of the year they had liquid resources of £466,000, compared with £77,000 cash at the end of 1921.

Referring to the reasons why the board had reduced the dividend from 15 to 10 per cent., the chairman pointed out that during the past few years the company had made very handsome returns to the shareholders by way of compensating them for the reduction of capital made in 1914, and for the non-payment of dividends during the subsequent three years. The share capital was reduced in 1914 by £235,000. No dividends were paid for 1914, 1915, and 1916, but in 1917 and 1918 they paid sufficient to average for those five years 6 per cent per annum. Then for 1919, 1920, and 1921 they paid 15 per cent. per annum, and for the past year the proposed dividend was 10 per cent. In addition, they issued 100 per cent. in bonus shares in 1920, bringing the capital up to £210,488. Then the capital was increased by share subscription to £458,563. Therefore, they had made good very nearly half the capital that was written off, and they had distributed in dividends during the nine years practically £200,000, making an average return on the written down and subscribed capital of practically 11 per cent. per annum. He did not think that that was bad; it was not too good, because an engineering business which did not return a minimum of 10 per cent. was not good enough, but he thought a 15 per cent. dividend could not be maintained when competition for orders was as keen as it was at present. Many firms at the present time were accepting orders at prices which only covered the cost of production without any profit, merely to keep the works going, so far as he could judge. They were fortunately not in that position. They could get sufficient orders at a reasonable profit to enable them to earn a moderate dividend even in bad times; but it would be a pity to strain their manufacturing resources in order to maintain an unduly large dividend. As it was, they were doing more work now at a smaller profit in order to earn 10 per cent. than they did last year with a dividend of 15 per cent.; that was to say, at the present time they had to refuse some orders because the price was too low, and they had to accept lower prices for the orders they took. How long that condition of things would continue was impossible for him to say. The payment of an interim dividend had been suggested and the matter was under consideration. There were some indications at present pointing to a steady, if not a quick, improvement in the demand for extensions of generating and power plant, and for the replacement of existing plants by the efficient type with which the Brush Co. was now so prominently associated. The satisfactory financial results of the various electricity supply undertakings—both municipal and company—were an encouraging sign, and they could confidently look forward to obtaining their share of the business, and, he trusted, at somewhat better prices than those now ruling.

Foreseeing the increasing demand for Brush-Ljungström turbo-generators, they had made provision for this by the new large shop at Loughborough. This building had now been completed, and the advantages of its increased capacity of output and economy in manufacture were now being felt. During the earlier years of manufacture of the Ljungström turbine, the demand for it in this country taxed to the full the capacity of their shops, but they had already commenced the development of the export market, and had supplied plant for Australia, India, South Africa, and other parts of the world.

One other factor which bore upon the prospects of the near future had been the compulsory hold-up of generating plant extensions in supply stations through the necessarily prolonged deliberations of the Electricity Commissioners. The Commissioners had adopted a policy of concentration of generating plant, combined with the distribution of energy over wider areas than were formerly being supplied. The Brush-Ljungström turbine, however, by reason of its high efficiency, had in many cases cancelled out the main advantages of the larger sets, and as a consequence stations which would otherwise have been closed down were now being allowed to develop to such a capacity as the conditions of the site permitted.

The conspicuous phase of the past year's operations had been the number of cases in which the 5,000- or 7,000-kW Brush-Ljungström sets had been installed, the anticipated economies in operation being secured in every instance. While the results in each case had been equally favourable, one instance might be mentioned where, after the plant had been in continuous operation for nine months, the trials demonstrated an overall thermo-dynamic efficiency of 76.4 per cent. This was the highest efficiency recorded for any turbine of less than 20,000-kW output, and was obtained without any increase in dimensions.

The transformer department continued to develop very satisfactorily, but in the rolling stock shops they had felt the effects of trade depression more than in the other departments. Electric tramway systems had suffered severely by decreased receipts during the past eighteen months. The inevitable consequence had been that they had postponed the renewal of rolling stock. Replacements could not, however, be indefinitely postponed, and there were already signs of new activity.

The expansion and improvement in the London transit facilities would not be without benefit to the company, and an important contract had recently been entered into for the supply of 200 of the new and improved type of omnibus body adopted by the London General Omnibus Co.

Lord Vaux of Harrowden seconded the motion, and the report was adopted.

Cuba Submarine Telegraph Co., Ltd.

The receipts for 1922 were £55,899 and the expenses £26,562. After providing for cable repairs, £4,760; income tax, £4,332; balance of E.P.D., £3,148; and two years' Corporation Profits Tax, £2,218; £14,881 remains plus £2,416 difference in exchange and £16,532 brought forward, making £33,829 to be dealt with. £10,000 has been added to general reserve. After paying 10 per cent., less tax, on the preference shares and 5 per cent. per annum and a bonus of 4s. per share, free of tax, on the ordinary shares, £6,629 is carried forward, subject to Corporation Profits Tax. The vacancy on the board caused by the death of Mr. C. W. Parish has been filled by the appointment of his son, Mr. W. W. Parish.

Canadian General Electric Co., Ltd.

The accounts for 1922 show an earned profit of $532,791 (against $1,707,340 for 1921). From this is deducted $428,227 for interest charges, leaving a net profit of $104,564, which, with $557,726 brought forward and the reserve at the end of 1921, $7,000,000, makes a total of $7,662,290. The dividends on the preference stock (7 per cent.) and on the common stock (8 per cent. per annum for the first quarter and 6 per cent. per annum for the remainder of the year) absorbed together $841,879, leaving an undivided surplus in the balance-sheet of $6,820,411. The directors have not considered it necessary to augment the depreciation reserve, which stands at $5,164,923. The dividend for 1921 on the common stock was 8 per cent. and a stock bonus of 20 per cent. was also distributed.—*The Times.*

Wycombe Borough Electric Light and Power Co., Ltd.

The annual report shows a gross profit of £22,185, as compared with £17,004 in 1921. After the payment of debenture interest, outstanding accounts, preference dividends accrued, income tax, and depreciation, and adding the amount brought forward from the last account, there remained a balance of £11,650. It was proposed to pay a final dividend of 6 per cent., free of tax, on the ordinary shares (in addition to an interim dividend of 4 per cent.); to place £5,000 to the general reserve fund; to contribute £1,000 to a reserve provision for superannuation; and to carry the balance (£650) forward. A total of £16,328 was spent on capital account during the year, making the total expenditure £144,265.

Bath Electric Tramways, Ltd.

In his review of the past year's working at the annual meeting last week, the Chairman, Mr. J. B. Hamilton, C.B.E., said that while the revenue had decreased for definite reasons, the working expenses had been reduced to an even greater extent. The powers to charge increased fares had lapsed, but with the support of the Bath Town Council and local authorities, application had been made for the continuance of a smaller increase. Although on the year's traffic figures this would mean a reduction of about £10,000 in revenue, it was hoped that the increase of traffic which would result would make up the loss. The company had spent money freely to keep the system in good condition, and a fund was being built up to provide for the renewal of the track when this became necessary.

Bromley (Kent) Electric Light and Power Co., Ltd.

At the annual meeting on April 12th, the chairman (Mr. F. E. Gripper, M.I.E.E.) presented the report, which was reviewed in our issue of April 6th. Mr. Gripper said that during the war and the period following it they had had to be content with an inadequate return upon the capital invested in the undertaking, and they had been unable to build up a reserve. Now they were in a position to make good these deficiencies, and there was every prospect of their being able to maintain this position. Prices to consumers had been reduced and it was hoped to make further reductions.

Western Union Telegraph Co., Inc.

The gross revenue for the year 1922 was $105,447,748 and the operating expenses, &c., amounted to $91,651,275, leaving a gross profit of $13,796,473, to which is added an income of $15,465,034 from investments and $43,063,693 brought forward, making a total of $72,325,200. From this is deducted interest on bonds, $2,306,850; appropriation for development of ocean cables, $2,000,000; dividends paid and declared, $6,982,694; and adjustments of surplus (net), $384,641; leaving a balance of $46,854,538 to be carried forward. The sum of $6,630,778 was spent on additions to and improvement of plant and equipment. New buildings in Philadelphia and Harrisburg (Pa.) were to have been occupied early in the present year. During 1922 a creosoting plant with an annual capacity of about 100,000 poles began operations. The substitution of copper for iron wire continued and the purchases of copper wire amounted to 8,400,000 lb. The company's engineers have developed an important modification of the multiplex telegraph system, by which several cities can be connected to one wire and any one of them operated directly with each of the others. The engineers have also developed apparatus for the direct working of cable circuits between the larger cities of the United States and the European termini. The necessary short connecting links having been laid and the apparatus installed, three of the ocean cables are now working on the new system and the other four will be changed over at an early date. A trial length of the new type of ocean cable developed by the Western Electric Co. was to have been ready for test in the early part of this year. The company's programme of extensions to Northern and Southern Europe is predicated upon the successful outcome of these tests.

The report states that taxation has greatly increased. It is now 110 per cent. above that of 1916, whereas the operating income has increased by only 21 per cent. Reference is made to the provision for employés' pensions and disability and death benefits, and to the amicability existing between the company and the Association of Western Union Employés. The Atlantic cable formerly owned by the Direct United States Cable Co. was handed over to the British Government in May, 1922. The cable from Miami (Florida) to Barbados was opened for service on August 29th. A claim for damages to Atlantic cables has been lodged with the Irish Free State Government. Tentative arrangements have been effected with an Italian company for a cable between Italy and the Azores. At the latter point the company plans to connect its proposed United States and Azores cable. In consequence of the conditions in Germany, negotiations incidental to laying a cable between New York and the North of Europe have not advanced.

Referring to the position of cables in the light of recent radio developments, the report states that it is considered that radio telegraphy must be looked upon as a potential ally rather than as a competitor. Most of the revenue of the company came from its land lines, and "if there had been no net income from the cables in 1922 the company's net income would not have been materially reduced."

Dutch Companies.

The directors of the Netherlands Cable Works Co. of The Hague state that not much alteration in the situation of the undertaking has taken place since the issue of the report for 1921. The competition of the Eastern neighbours in 1922 was equally as keen as in the two preceding years. Now and then some advantage was gained by the company because the delivery of cables ordered in Germany did not always take place promptly, although this did not enable the company to raise prices to an appropriate level. During the year an agreement was entered into with the International Western Electric Co., of New York, under which the Dutch company secured the right to manufacture duplex cables with Pupin coils, and a length of 48 miles of such telephone cable was now in hand. The working results for 1922, although not on a level with those in previous years, could still be regarded as satisfactory. The gross profits amounted to 685,000 fl., as compared with 1,106,000 fl. in 1921. After writing off 127,000 fl. for depreciation, as against 424,000 fl., the balance and the sum brought forward permit of the payment of a dividend at the rate of 15 per cent., this contrasting with 17 per cent. in 1921. It is added that some temporary advantage may be gained from the occupation of the Ruhr, which has placed difficulties in the way of German exports to Holland.

The Dordt Electric Motor Co., of Dordrecht, reporting on the past year, states that the sale prices of electric motors continued to fall. Although wages and salaries were lower, these factors in favour of reducing the costs of production were unable to counterbalance the reduction in sale prices. The greatly diminished purchasing capacity, as well as a frequently misplaced economy on the part of buyers in purchasing according to price and not according to quality, was the cause of the price fall in conjunction with competition from countries having a depreciated currency. The competition of German manufacturers would have been considerably less if it had not been for the very large stocks held, both in Holland and Germany, the owners of which sold at any prices obtainable at paper profits. The danger of competition arising from depreciated exchanges was also threatened from countries such as France and Belgium; exports to Belgium were already almost impossible, whereas the imports from that country were increasing. Nevertheless the turnover in 1922, expressed in the number of motors or horse-power, was not notably less than in the previous year. The accounts show a loss of 21,000 fl. for the year, as against 8,500 fl. in 1921.

Indo-European Telegraph Co., Ltd.

At the general meeting next Wednesday, the directors will recommend a final dividend of £1 2s. 6d. per share, free of tax, for 1922, making 7 per cent. for the year. This presents no difficulty owing to the arrangements of which the company has the benefit. The 1922 accounts cannot be ready for probably another three months. In those accounts provision will be made for the items now standing as Russian freeholds and investments, and sums due from the former Russian Government. During 1922 the company's line in Poland and in South Russia was rebuilt entirely in places, and repaired in other places. This involved the company and its engineer and staff in a very heavy amount of work, attended by a certain amount of delay due to unexpected causes. The expenditure to the end of 1922, under this heading, is £155,000. As a result, with the co-operation of the Russian and Polish Governments, the company has had, since November, 1922, a through wire, in good working order, between Warsaw and Teheran, a distance of nearly 3,000 miles. This has been, and is, carrying a satisfactory amount of international traffic. By the early summer, it is anticipated that the company's line, between the German frontier and Teheran, will be completely restored on the pre-war scale, and be equal to all traffic demands. Although the company has an efficient wire between Warsaw and Teheran, it is still unable to re-open its route from the United Kingdom. All arrangements with the General Post Office for the provision of the necessary land line and cable facilities up to the German Coast have, for some time, been completed, but the concession from the German Government, long agreed in principle, still remains unsigned. This is due to the intervention of questions affecting a number of telegraph administrations outside the company, and the delay is entirely beyond the directors' control. They hope, at the forthcoming meeting, to be in a position to give the shareholders satisfactory information on this point, and

on the position of the company generally. Consequent upon the death of Mr. T. W. Stratford-Andrews, the directors have appointed Mr. Axel W. Berg, a director, to be acting managing director.

Stock Exchange Notices.—Dealings in the following have been specially allowed by the Committee under Rule 159:—

Brompton and Kensington Electricity Supply Co.—4,845 ordinary shares of £1 each, fully paid, Nos. 285,466 to 290,310.

Scarborough Electric Supply Co.—£60,000 6 per cent. first mortgage debenture stock, issued at 95 per cent., partly paid and fully paid.

Yorkshire Electric Power Co.—250,000 new ordinary shares of £1 each, issued at 23s. per share, fully paid and partly paid, Nos. 835,001 to 1,085,000.

The undermentioned securities have been ordered to be officially quoted:—

Auckland Electric Power Board.—£350,000 5½ per cent. Electric-power Extension debentures, 1922, of £100 each (Nos. 1 to 3,500) (bearer).

Tilling-Stevens Motors, Ltd.—The profit for 1922 was £22,860. It is proposed to transfer to depreciation £16,000, leaving £7,860, which falls to be deducted from the balance at debit of profit and loss account at December, 1922 (£166,382), leaving £158,522 to be carried forward.

Calcutta Electric Supply Corporation, Ltd.—Final dividend on the ordinary shares, for the last half of 1922, at the rate of 6 per cent. actual, making 10 per cent. for the year, plus a bonus of 1 per cent. Relief as heretofore in respect of Indian taxation.

Great Northern Telegraph Co.—Total dividend and bonus for the year 1922 of 22 per cent., including 5 per cent. already paid; £33,333 to the reserve and renewal fund; £55,556 to the pension fund; carrying forward £309,762.

Babcock & Wilcox, Ltd.—Final dividend of 9 per cent., free of tax, for the half year together with a bonus of 3 per cent., free of tax, making a total of 20 per cent. for 1922, as compared with 16 per cent. for 1921.

Montevideo Telephone Co., Ltd.—Interim dividend on the ordinary shares for half-year ending January 31st, 1923, at the rate of 4 per cent. per annum, less tax.

Brazilian Traction, Light & Power Co.—Quarterly dividend of 1 per cent. on the ordinary shares.

Anglo-American Telegraph Co., Ltd.—Interim dividend for the quarter ended March 31st of 15s. per cent. on the ordinary stock and £1 10s. per cent. on the preferred stock, less tax.

British L.M. Ericsson Manufacturing Co., Ltd.—Dividend of 8 per cent., free of income tax, on ordinary shares for 1922, carrying forward £43,913, subject to Corporation Profits Tax.

STOCKS AND SHARES.

Tuesday Evening.

The Budget exercised a favourable effect upon the prices of most investment securities. It had been generally expected that there would be a small reduction in the Income Tax, and the halving of the Corporation Tax is accepted as a precursor of its complete abolition next year. The other changes in the Budget affect to a very slight extent the various markets round the Stock Exchange. Tobacco shares, which have recently been such a feature of strength, went ahead further, under the stimulus of the Chancellor's decision not to reduce the duty on the weed. From the individual standpoint of electricity companies, no changes can be said to have occurred in the prices of the shares as a result of the Budget, except that, as just mentioned, investment stocks and shares are strengthened by the modest remissions in the Income and Corporation taxes.

Amongst electricity supply shares, further advances have occurred this week in City Lights, County of London, Charing Cross, Chelsea, Metropolitans, St. James's and Westminsters, the rises ranging from sixpence to five shillings per share. In addition, Edmundson's ordinary and Urban ordinary have both gained half-a-crown, at 2⅞ and 1¾ respectively, dividend anticipations being responsible for these improvements. Bournemouth & Poole advanced to 14. The market shows pronounced strength, and the amount of stock on offer is, as usual, exceedingly small. There has been some buying of County of London Electric 6 per cent. new preference, which stand at 2s. 6d. premium, but which do not rank equally with the old for full dividends until after January next. The difference of a shilling in the price between the old and the new shares is thus accounted for, and to those who are looking for appreciation in the future, the new are a shade cheaper than the others. New County ordinary have appreciated to 16s. premium. Midland Counties Electric 6 per cent. preference remain about their par price of 20s., and on these there are partial dividends in September this year and in March, 1924. Afterwards, they receive the full 6 per cent., and, considering the nature of the security, may be considered a good investment. Whitehall Electric 7½ per cent. preference continue in request up to 19s. 6d., buyers being attracted by the yield of £7 12s. per cent., though this implies naturally a certain amount of risk.

Anglo-Argentine Tramways have fallen again, in consequence of the friction that has arisen between the company and the municipality of Buenos Ayres. Briefly put, the municipality insists upon a reduction in fares, which, if conceded, the company says will make it impossible for it to proceed with the construction of a projected tunnel for the better handling of traffic during rush hours. Furthermore, it is hinted that a lowering of the fares would force upon the company the necessity for reducing wages. All the elements of an unpleasant dispute are thus presented, and some of the more nervous shareholders have been selling not only their preference shares, which have dropped sharply, but also the 5 per cent. debenture stock, which has given way a couple of points. The market view is that although there may be a difficult period to plough through before agreement is again reached, the end is likely to be something in the nature of a compromise that will leave matters very much where they stood before the trouble arose. The first preference have dropped to 3⅞, and the seconds to £3 per share.

Brazilian Tractions are better at 54, and the demand for investment securities has lifted British Columbia Electric Railway preference stock a point to 84½, although the deferred at 88½ is similarly down. The Mexican issues mark time, except in the Tramways Common, which are 2 higher at 41½. There is next to nothing doing in any of the stocks, pending the daily-expected news of a settlement between Mexico and the United States on those points which still bar the way to a general recognition of Mexico, and its expected corollary, a loan from the United States to its smaller neighbour. The London group of traction issues is quiet, London & Suburban preference at 11s. showing no change.

In the cable market, Eastern Extension, Eastern Telegraph ordinary, Globes and Westerns are all better. This week's recovery wipes out the falls that took place a month ago, when some timid folk were rendered apprehensive by the development of broadcasting and of wireless possibilities. As it has been frequently pointed out, experience in the past has shown that there is plenty of room for both systems to work profitably as well as amicably. It is a little ironical to observe that Marconis have again given way, the price dropping to 2 7/16, in consequence of a question having been raised as to whether the British Broadcasting Co. can claim such a monopoly as it is supposed to possess. The Marconi Co. is, of course, associated with the B.B.C. Moreover, the Stock Exchange market has been quick to observe the fact, broached here a fortnight ago, that the Marconi Co.'s programme of a two million pounds expenditure upon new stations may conceivably involve a new issue of capital, although some think that the money would be subscribed through the medium of colonial and foreign subsidiary undertakings. Radio Corporation shares have improved a little, on American support, but Canadian Marconis sagged to 10s. Cuba Submarines at 8 are 10s. higher.

The Electric Construction's dividend of 10 per cent. has had a strengthening effect upon the price of the shares, which is up to 28s. 9d., and English Electric preference improved to 19s., on the 5 per cent. dividend declared on the company's ordinary shares. The recent buying of General Electrics, and of shares in other companies that are known to be doing well out of the sale of broadcasting apparatus, has been checked for the time being, but the prices hold their previous levels. Babcox & Wilcox are the feature amongst engineering shares, a jump of 3s. 9d. to 4½ being accompanied by persistent optimism with regard to the dividend announcement now due. Metropolitan-Vickers preference remain at 50s. British Aluminiums rose to £1, and Callender's at 2 9/32 are 7½d. better. The small parcel of Callenders 6½ per cent. preference which came on offer last week at 23s. was quickly snapped up, but there remain a few hundreds of the company's 7½ per cent. "B" preference obtainable at 26s., and so offering a yield of 5¾ per cent. on the money. These also are being steadily taken by investors who appreciate the security, at the back of the issue, provided by the excellent dividends paid on Callender's ordinary shares. Interest in Siemens has somewhat waned, and other shares in the manufacturing list, while they continue to attract a quiet amount of business, are practically unchanged.

The 4½ per cent. debenture stocks of the Tube companies which were issued a little while ago under Government guarantee, are now standing within a point of 100, and, what is more, they are practically unobtainable. Dealers in the Stock Exchange market are apt to deplore the fact that the companies must be well supplied with capital at the present time, the regret being occasioned by the fact that there is so great a demand for stocks of this character that the issue of a few millions upon tempting terms would provide them, the jobbers, with a more liberal supply of stock in which to deal. The railway market is good as a whole, and the strength has spread to Metropolitans and Central London assented stocks. Districts are a trifle easier. Underground Electric Income Bonds are better at 96½, and the reduction in Income Tax has proved no drawback to the demand for such stocks as this upon which the dividends are paid free of Income Tax.

The rubber market is somnolent, although the reduction in the amount of visible rubber on hand goes on quietly every week. The price of the raw material, however, keeps dull at 1s. 4¼d. per lb. Iron, coal and steel shares are generally a little better by reason of the impression that the chaos in the Ruhr field is a distinct advantage to British companies engaged in such branches of industry.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Nom.	Dividend. 1921.	Dividend. 1922.	Price April 17. 1923.	Rise or fall.	Yield p.c.
	£					
Brompton Ordinary	1	12	12	36/6	—	£6 11 4
Charing Cross Ordinary ...	5	9	14	10⅞	+⅛	6 15 0
do. do. do. 4½ Pref.	5	4½	4½	4½	—	5 6 0
Chelsea	5	6	10	8⅛	+ ⅛	6 3 0
City of London	1	14	15	2 7/16	+ 1/16	6 3 0
do. do. 6 % Pref. ...	1	6	6	23/-	—	5 4 4
County of London	1	8	10	38/9	+ 1/16	5 3 3
do. do. 6 % Pref. ...	1	6	6	1⅛	—	5 4 4
Edmundson's Ordinary	3	Nil	—	2⅜	+ ⅛	Nil
do. 6 % Pref. ...	5	12/-	—	4⅜	—	6 13 4
Kensington Ordinary	5	10	12	8½	—	6 13 4
London Electric	3	4	10	4⅜	—	6 11 7
do. do. 6 % Pref. ...	5	6	6	5⅛	—	5 17 1
Metropolitan	1	7	8½	28/6	+6d.	5 19 4
do. 4½ % Pref.	1	4½	4½	17/-	—	5 6 0
Newcastle-on-Tyne Ordinary ...	1	Nil	2½	7/8	—	2 17 2
do. 5 % Pref. ...	1	5	5	15/-	—	6 13 4
do. 7 % Pref. ...	1	7	7	23/6	—	5 19 2
Notting Hill, 6 per cent. Pref....	10	6	6	9½	—	6 9 9
North Met. Elec., 6 % Pref. ...	1	6	6	1 1/16	—	5 13 0
Urban Ordinary	3	Nil	—	1⅜	+ ⅛	Nil
do. 5 % Pref. ...	5	2½	—	4½	—	5 17 8
St. James' and Pall Mall ...	5	12	14½	10⅞	+ ½	6 15 0
South London	4	7	10	6⅝	—	5 16 3
South Metropolitan Pref. ...	1	7	7	1 5/16	—	5 14 10
Westminster Ordinary	5	10	12	9	+ ½	6 13 4
Whitehall Elec. Invst., 7½ % Pf.	1	7½	7½	19/6	—	7 13 10

Home Rails.

Central London Ord. Assented	Stock	4	4	72	+1	5 11 1
Metropolitan	,,	2½	3⅛	69½	+1	5 0 9
do. District	,,	1	3	55½	− ½	5 8 2
Underground Electric Ordinary	10	Nil	Nil	2½	—	Nil
do. do. "A" ...	1	Nil	Nil	9/6	—	Nil
do. do. Income	Stock	4	5	96½	+1	*5 3 9

Telegraphs and Telephones.

		Dividend. 1920.	Dividend. 1921.			
Anglo-Am. Tel. Pref.	Stock	6	6	104½	+ ½	5 14 10
do. Def.	,,	1½	34/6	22⅜	—	6 13 4
Chile Telephone	5	6	6	6⅜	—	4 16 0
Cuba Sub. Ord.	10	7	7	8	+ ⅛	8 15 0
Eastern Extension	10	10	10	18⅜	+ ⅛	5 9 7
Eastern Tel. Ord....	Stock	10	10	185½	+ 2	5 7 10
Globe Tel. and T. Ord.	10	10	10	18½	+ ⅛	5 8 1
do. do. Pref.... ...	10	6	6	11⅛	—	5 6 8
Great Northern Tel.	10	24	24	29½	+1	7 9 2
Indo-European	25	10	10	37½	—	6 13 4
Marconi	1	25	15	2 7/16	− ⅛	6 3 0
Oriental Telephone Ord. ...	1	12	12	2 1/16	—	*4 5 5
United R. Plate Tel.	5	8	8	7⅛	—	*5 6 8
West India and Panama ...	10	Nil	Nil	5/-	—	Nil
Western Telegraph	10	10	10	18½	+ ½	*5 8 1

Home and Foreign Trams, &c.

Anglo-Arg. Trams. First Pref.	5	5½	12½	8⅜	− ⅛	8 3 0
do. do. 2nd Pref.	5	Nil	5½	3	− ⅜	9 3 4
do. do. 5 % Deb.	Stock	5	5	80	−4½	6 5 0
British Electric Traction Ord.	,,	4½	—	74½	—	6 0 10
do. do. 6 % Pref.	,,	6	6	99	—	6 1 3
Brazil Tractions...	100	Nil	Nil	54	+1	7 8 2
Brit. Columbia Elec. Rly. Pcs.	Stock	5	5	84½	+1	5 18 4
do. do. Preferred	,,	5	93/-	77½	—	*6 1 3
do. do. Deferred	,,	3	124/-	88½	−1	*6 19 9
do. do. Deb. ...	,,	4½	4½	78	—	5 8 3
Lond. & Sub. Trac. 5 % Pref.	1	2½	3½	11/-	—	9 2 0
London United Tram. Deb. ...	Stock	4	4	65	—	6 3 0
Mexico Tram. 5 % Bonds ...	—	Nil	Nil	51½	—	6 2 8
do. 6 % Bonds ...	—	Nil	Nil	61½	—	Nil
Mexican Light Common ...	100	Nil	Nil	22½	—	Nil
do. Pref.	100	Nil	Nil	69½	—	Nil
do. 1st Bonds ...	—	Nil	5	66½	—	7 11 3

Manufacturing Companies.

Babcock & Wilcox	1	15	16	4⅛	+ 3/16	8 17 8
British Aluminium Ord. ...	1	10	5	1	+ 1/16	5 0 0
British Insulated Ord.	1	15	15	2½	—	6 8 0
Callenders...	1	15	15	2 3/16	+ 3/16	6 11 7
do. 6% Pref.	1	6⅜	6⅜	1⅛	— 1/16	5 15 7
Crompton Ord.	1	10	5	⅞	— 1/16	6 13 4
Edison-Swan	1	10	Nil	4/8	—	Nil
do. do. 5 % Deb.	Stock	5	5	61	—	8 1 4
Electric Construction	1	10	10	28/9	+9d.	6 19 2
English Electric	1	8	5	17/9	—	5 12 8
do. do. Pref.	1	6	6	19/-	+6d.	6 6 4
Gen. Elec. Pref.	1	6½	6½	22/9	—	5 14 3
do. Ord.	1	10	5	21/9	—	4 12 0
Henley	1	15	15	47/6	—	6 6 4
do. 4½ Pref.	5	4½	4½	4⅜	—	5 2 10
India-Rubber	1	10	—	⅜	—	—
Met.-Vickers Pref.	2	8	8	2½	—	6 8 0
Siemens Ord.	1	10	10	21/3	—	Nil
Telegraph Con.	12	20	20	25½	—	*4 16 0

* Dividends paid free of Income Tax.

MARKET QUOTATIONS FOR CHEMICALS AND METALS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general and they may vary according to quantities and other circumstances

CHEMICALS, &c.	Price April 18th.	Fortnight's Inc. or dec.
a Acid, Oxalic ... ... per lb.	6¾d.	...
a Ammoniac, Sal ... ... per ton	£60	...
a Ammonia, Muriate (large crystal) ,,	£51	...
a Bisulphide of Carbon ... ... ,,	...	...
a Borax ... ... ,,	£28	30/- inc.
a Copper Sulphate ... ... ,,	£26 15s.	...
a Potash, Chlorate ... ... per lb.	4d. to 4½d.	...
a ,, Perchlorate ... ... ,,	5d.	...
a Shellac ... ... per cwt.	£18	...
a Sulphur, Sublimed Flowers ... ,,	£9	...
a ,, Lump ... ... ,,	£8 10s.	...
a Soda, Chlorate ... ... per lb.	3d.	...
a ,, Crystals ... ... per ton	£5 10s.	...
a Sodium Bichromate, casks ... per lb.	4½d.	...
METALS, &c.		
b Aluminium, Ingots ... ... per ton	£105 to £110	...
b ,, Wire ... ... per lb.	1/9 to 2/6	...
b ,, Sheet ... ... ,,	1/6 to 2/-	...
p Babbitt's Metal and Anti-friction Metal—		
Grade I ... ... per ton net	£198	£10 dec.
Grade II ... ... ,, ,,	£142	£6 dec.
Grade III... ... ... ,, ,,	£79	£2 dec.
c Brass (rolled metal 2" to 12" basis) per lb.	10¾d.	...
c ,, Tubes (solid drawn) ... ,,	1/1 to 1/1½	...
c ,, Wire, basis ... ... ,,	11d.	...
c Copper Tubes (solid drawn) ... ,,	1/2¾d.	...
c ,, Bars (best selected) ... per ton	£105	...
c ,, Sheet ... ... ,,	£106	...
c ,, Rod ... ... ,,	£106	...
d ,, (Electrolytic) Bars ... ,,	£81 10s.	40/- dec.
d ,, ,, Sheets ... ,,	£145 10s.	...
d ,, ,, Wire Rods ,,	£91 10s.	40/- dec.
d ,, ,, H.C. Wire per lb.	11 1/16d.	½d. dec.
f Ebonite Rod ... ... ,,	3/6	...
f ,, Sheet ... ... ,,	3/-	...
a German Silver Wire ... ... ,,	2/6	...
h Gutta-percha, fine ... ... ,,	5/6	...
h India-rubber, Para fine ... ... ,,	1/3½	...
l Iron Pig (Cleveland Warrants) ... per ton	92s. 6d.	...
l ,, Wire, galv. No. 8, P.O. qual. ,,	£25	£1 inc.
g Lead, English Pig ... ... ,,	£27 15/-	30/- dec.
g Mercury ... ... per bot.	£10 5s. to £10 10/-	30/- dec.
e Mica (in original cases) small ... per lb.	3d. to3/-	...
e ,, ,, medium... ,,	4/- to 8/-	...
e ,, ,, large ... ,,	10/- to 20/- & up.	...
p Phosphor Bronze, plain castings ,,	1/2	...
p ,, drawn bars and rods ,,	1/4	...
p ,, rolled strip & sheet ,,	1/3½	...
p ,, wire ... ... ,,	1/5	...
o Platinum ... ... per oz.	£23	...
d Silicium Bronze Wire ... ... per lb.	1/2	...
r Steel, Magnet, in bars ... ... ,,	10d.	...
n Tin, Block (English) ... ... per ton	£209 10s. to £210	10/- dec.
n ,, Wire, Nos. 1 to 16 ... ... per lb.	3/5	...

Quotations supplied by

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
l Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p C. Clifford & Son, Ltd.
r W. F. Dennis & Co.

Electrical Progress in the United States.—According to a survey made by the *Electrical World*, the electrical industry has laid plans for record additions and extensions to equipment during 1923. Returns were received from more than 200 companies, representing about 70 per cent. of the installed generator rating of the country. The total value of the additions that will be made to the generating, transmission, and distribution systems during the present year is estimated at $602,143,000, which is about 86 per cent. greater than the estimated expenditures made during 1922, and about 180 per cent. more than the 1921 expenditures.

The estimated new generating installations during 1923 total 2,890,400 kW, of which about 68.8 per cent. will be for steam-electric plants and about 31.2 per cent. for hydro-electric plants. In 1922 it was estimated that 1,772,000 kW was added to the generating equipment of the central stations, of which about 58 per cent. was for steam-electric plants and 42 per cent. for hydro-electric plants, while in 1921 it was estimated that only 1,251,000 kW in generator equipment was installed during the year, of which 72 per cent. was for steam-electric plants and 28 per cent. for hydro-electric plants. The new generator installation in 1923 will, therefore, probably exceed that of 1922 by about 63 per cent. and that installed during 1921 by about 131 per cent. The estimates are for additions to systems which were operating prior to January 1st, 1923, and do not include the systems of new operating companies organised during 1923, the expenditures of which are, of course, impossible of computation at the present time.

Electric Bells for Notre-Dame.—The bells of the Cathedral of Notre-Dame are in future to be worked by means of electrical mechanism, and it is expected that the installation for this purpose will be completed very shortly.—*The Times.*

NOTES ON INSULATORS.

By G. L. E. METZ.

Long-distance power transmission demands certain qualities of insulation, and the necessary development to meet these conditions has perhaps lagged behind other factors of the undertaking. In the following article a few applications of general theory to this subject are made, and some of the most salient factors necessary for the production of an extra-high-pressure insulator are given; it is hoped that they may be of some value as a reference.

The Qualities Required for Porcelain Insulators.

While the design of many insulators is, so far as the utilisation of material is concerned, a matter of the most efficient design of the boundary surface between the air and the supporting dielectric with a view to avoiding undue electrical or mechanical stresses, the material embodying the insulator itself becomes of greater importance as the working voltage increases.

Although far from being ideal, porcelain at the present moment appears to be in vogue as the best commercial material to employ for the manufacture of high-pressure insulators, and a few essentials of the material are given below.

Mechanical Strength.—Porcelain, unfortunately, is a very brittle substance, and, like glass, has no yield point short of complete rupture; bearing in mind that an insulator's first duty is to act as a support and withstand any mechanical strain not severe enough to destroy any other portion of the circuit, its mechanical strength is of vital importance. The results of tests taken by many leading manufacturers have shown that whether in tension, compression, or both, porcelain can be used quite satisfactorily, provided its safe strength, allowing a fair factor of safety, is not exceeded.

Safe Strength of Porcelain.

Compression.	Tension.
40,000 lb. sq. in.	1,500 lb. sq. in.

Temperature.—Insulation often encounters sudden changes of temperature while in service, and any porcelain that will not satisfactorily withstand an indefinite number of changes from extreme heat to extreme cold is absolutely unsuited for insulator work.

Where cement and metal guard rings are used, they should be so arranged that any expansion caused by an increase in temperature would not set up undue stresses on the surface of the porcelain, cracking the glaze.

Porosity.—Porosity, with consequent absorption of moisture and reduction of insulating value, is an evil met with in certain mixes of porcelain. Unfortunately, it is impossible to test every insulator, but from each batch certain samples should be selected and subjected to a penetration test under great pressure.

Voltage Gradient; Effect of Temperature, Shape of Electrode, and Air Density on Corona.

Whenever electrical energy flows along a conductor it sets up two fields:—(1) Magnetic field; (2) dielectric field. The importance of care in the design of a magnetic circuit is fully appreciated by all engineers, but the design of the dielectric circuit is not so generally understood. Very probably this is due to the fact that a badly-designed magnetic circuit makes itself felt very plainly in the form of losses, while the dielectric circuit, if badly designed, gives no indication of weakness until rupture occurs.

Now, considering magnetic and dielectric fields, they may be treated in a similar manner; for instance, to establish a magnetic field, a magnetomotive force is necessary; similarly, to establish a dielectric field, an electromotive force is necessary.

In a magnetic circuit, if the same flux passes through varying cross sections, the magnetomotive force will not divide up equally over equal lengths of the circuit. Where the lines are crowded together, the magnetomotive force per unit length of magnetic circuit will be larger than where the lines are not crowded. Likewise for the dielectric circuit, where the dielectric flux density is high, a greater electromotive force per unit length of circuit is required than at parts where the flux density is low.

Now, electromotive force or voltage per unit length of dielectric circuit is called electrifying force or voltage gradient G, corresponding to H for magnetic circuits.

Then, just as the introduction of a material of high permeability, such as iron, increases the flux for a given magnetomotive force H, so the introduction of a material of high specific capacity into a dielectric circuit, such as glass, will increase the flux for a given electrifying force G; and, further, should an air gap be introduced into both circuits, just as the value of H in the magnetic circuit is much higher across the air than across the iron, so G in the dielectric circuit is much higher over the air than over the glass.

But insulation breaks down at any point when the flux density at that point exceeds a given value; it is therefore of great importance to have uniform flux density. The dielectric flux varies directly with the capacity and voltage, and, just as the flux density in magnetic circuits is fixed by the proportion of permeability, magnetomotive force, and sectional area, so the dielectric flux density depends on the dielectric capacity of insulation, voltage gradient, and cross section.

Strength of Air.—Regarding the strength of air, it is advisable to remember that the size of electrode, the temperature, and the barometric pressure affect the maximum gradient that it will stand.

Considering the size of electrode, it is apparent that if two spheres of fairly large dimensions are spaced six inches apart, and two needle points are placed a similar distance apart, the air between the needle points will break down at a much lower voltage than the air between the sphere gaps, due to the fact that the flux density at the needle points is much higher than the flux density at the surfaces of the spheres. This property indicates that sharp corners must be avoided in the design of insulators for service on extra-high-pressure systems, and every part must be of ample size and well rounded.

Effect of Temperature on the Strength of Air.—For concentric cylinders:—

$$G\ v = 31\ a\ (1 + .308/a\ r)\ \text{kV per cm. max.}$$

where G v = max. gradient.

31 kV = normal breakdown of air at 25° C. and a barometric pressure of 76 cm.

r = radius of inner conductor.

$a = 3.92b/(273+t)$

$(273+t)$ = absolute temperature.

b = barometric pressure in cm.

Calculation of Gradient for Concentric Cylinders.—In this case the lines of force are radial, hence the equipotential surfaces are concentric cylinders; the whole of the insulator may therefore be considered as a number of capacities in series, each capacity being between two equipotential surfaces and dr cm. apart.

The gradient for a bushing-type insulator is given by—

$$G = v/r \log_e (R/r) \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where v = maximum instantaneous value of test pressure.

R = external radius of insulator.

r = radius of inner conductor.

When designing a bushing-type insulator, the allowable gradient for the particular insulating material used is a known quantity; the maximum test pressure

the insulator will have to stand is also known; therefore R and r, the external and internal radii, become the variables in equation 1.

It can be seen that any method of design which starts from an arbitrary assumed value of either R or r is apt to lead to a larger and more costly bushing than the actual working conditions require, and the simple rules given below show how the most economical design can be obtained. There is for each given value of R, that is, the external radius of the bushing-type insulator, a best value of r, and if the radius of conductor r be greater or less than this value, a greater stress will result on the insulation. The condition giving minimum gradient is obtained when the ratio $R/r = 2.72$,

and $r = R/2.72$ .....(2)

this expression being simply obtained by differentiating equation 1 and equating to zero.

Now, equation 2 gives the best value of r to employ when R is known; the next step is to obtain the minimum safe value of R, the external radius of the insulator.

In practice, the maximum permissible gradient G for any particular insulating material is known, and the test pressure V is known, so by substituting these values together with $R/r = 2.72$ in equation 1, we find—

$$R = 2.72\ (V/G) \quad \text{.....(3)}$$

which gives the minimum value of R it is safe to employ. By means of the three simple equations given above, we see that it is possible to design a bushing-type insulator, but they will only apply where the bushing is of homogeneous character. Very often, in fact in the majority of cases, the bushing-type insulator is made up of two parts—air and insulation—in which case formula 1 is modified to—

$$G = V\ K/r \log_e (R/r) + V/r \log_e (R/r),$$

where K=specific inductive capacity of the insulation concerned. The stress is split up, part on the air and part on the insulation; under these circumstances the methods given above, however, may still be employed.

WIRELESS SETS.

By F. A. P.

The position at which wireless telephony has arrived is reflected in the recent exhibitions, and a brief survey of the latter gives one the impression that some difference of opinion exists as to the most suitable type of apparatus for which there is likely to be a demand, and, further, that there is a multiplication of types tending rather to confuse the average purchaser.

Although at the present time it is premature to predict the most serviceable type for home use until the broadcasting scheme has been thoroughly tested, and also owing to the improvements in circuits which are continually being made, yet as the use of wireless apparatus promises to become universal, it would seem advisable to install thoroughly practical sets. The amateur enthusiast may require to have his inductances, condensers, valves, &c., in separate units in order to take advantage of the possibilities of experimenting with the various circuits and exploring all the fields wireless covers, such a useful scientific and social hobby which can be pursued from the most simple and inexpensive beginnings perhaps having never before been evolved. On the other hand, home apparatus for the reception of broadcast telephony must be suitable for use by anyone, and should be as self-contained as any other household appliance.

Although America has had some experience of broadcasting, the position there is complicated by the number of amateur sending stations at work, and, owing to the restrictions likely to be enforced in this country, the practice there cannot be followed closely, each country tending to evolve the most suitable type to meet respective conditions.

The simple crystal set, for receiving local broadcasting, now on the market, and containing detector, small inductance or variometer, &c., with separate headgear receiver housed in a section of the case, seems only fairly well to provide the required equipment. An improvement in the loud speaker or in the efficiency of transmission might put the headgear out of court entirely and necessitate a separate piece of apparatus with a consequent duplication of apparatus and connecting cords. One can hardly doubt that the loud speaker will eventually displace the headgear receiver; the convenience of the former is so perceptible.

Two common pieces of apparatus in everyday use, *viz.*, the telephone and gramophone, with which we have had long experience, perhaps suggest more suitable arrangements. In the ordinary, or subscriber's, telephone set, the practical part containing the transmitter and receiver in compact form usually stands on the table or desk, and is connected by a cord to the case, mounted on the wall near at hand, containing the remainder of the apparatus. This has proved a very compact and satisfactory arrangement, and the wireless set might very well be developed on these lines. The detector, with its regulating handle or handles, could be mounted on the wall and the loud speaker stand on a table, or, if we must really have the headgear receiver, a suitable stand could be devised to carry it, probably in the form of a trough, owing to its being one of the most awkward things imaginable to support. While this type might be very suitable for the reception of local broadcasting, many people would prefer to be able to hear the more distant stations, and containing-cabinets similar to those used for gramophones might be used to house the more elaborate apparatus then necessary. Several makers are using large cabinets of this type which stand on the floor, but hardly with a view to altering the internal arrangements as required to meet new methods, although perhaps as these have ample space for almost any apparatus, including a desirable separate compartment for batteries, alterations and additions could be fairly easily carried out. The smaller type of cabinet, however, made to stand on a table and having a hinged lid, may become an even more popular container for wireless apparatus and would embody the horn of the loud speaker when required. Both types of cabinets are being increasingly made by cabinet makers as articles of furniture to house gramophone units, and could be admirably adapted for wireless apparatus. What is required, however, is that they should be made of standard size, and makers of the instruments could then arrange their apparatus in suitable sizes to fit any case. Thus an expensive cabinet need never contain obsolete apparatus, and would last as long as ordinary household furniture.

Another point that does not seem to have been fully developed relates to the earthing switch. As long as the aerial is a necessary part of the equipment some form of switch will be required to earth it during storms and when the apparatus is not in use as a protection from lightning. This might very well take the form of a plug and socket or jack if the latter could be made substantial enough. The springs of the jack would then automatically earth the aerial when the apparatus plug was withdrawn.

G.E.C. OIL-IMMERSED MOTOR CONTROL GEAR.

Rotor Starters and Horizontal Drum Controllers.

In view of the interest that is being taken in oil-immersed motor control gear, it will not be out of place to direct attention to two ranges of apparatus of this class manufactured by the General Electric Co., Ltd.

Oil-immersed rotor starters are designed in two patterns, the first suitable for ordinary industrial purposes and the second for use in fiery mines. Several standard sizes are manufactured, ranging from 10 to 240 h.p., and a general idea of the construction of these units is given by figs. 1 and 2. It should be particularly noted that the resistance contacts are at the top of the oil tank, thus enabling inspection to be carried out without lifting the unit completely out of the tank; at the same time any danger of the oil not fully covering the contacts is avoided, as ample provision is made for a large head of oil above them. The resistance element is wound on porcelain bobbins which are secured to the slate base on which the contacts, movable arms, &c., are mounted. The bottoms of the porcelain bobbins are fixed to wrought-iron straps, which act as stays and prevent damage during transit.

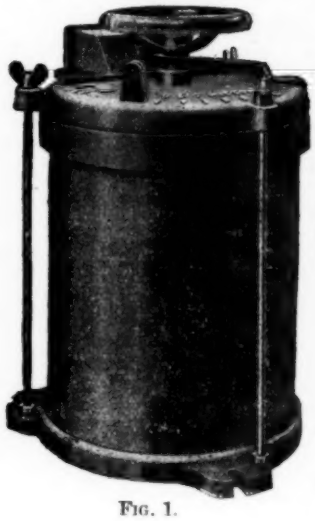


Fig. 1.

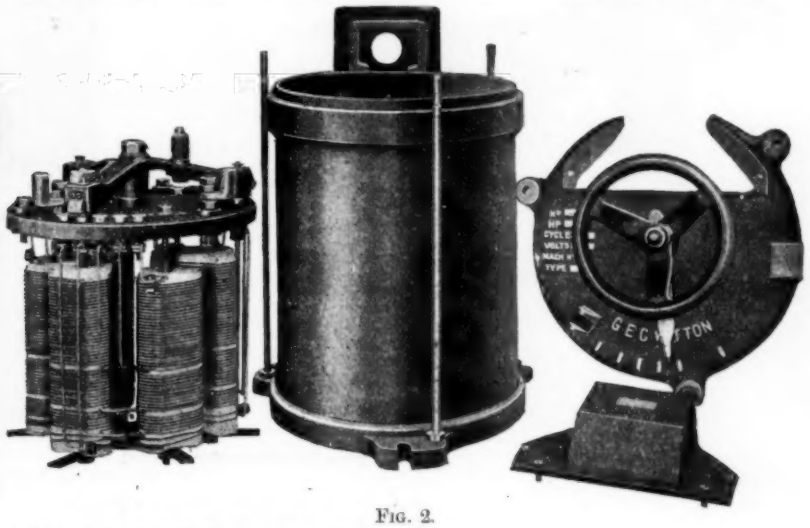


Fig. 2.

Figs. 1 & 2.—G.E.C. Oil-immersed Rotor Starter.

The tank is of welded steel, and in the fireproof starter it is made of suitable thickness to withstand any internal explosion, the top of the tank being provided with the usual machined joints. The inspection cover seen at the right-hand bottom side of fig. 2 fits over the back of the lid, and its removal enables preliminary inspection to be made; in the case of the design for use in fiery mines, a screwed inspection plug is fitted.

The starters are provided with a step-by-step slow-motion device, and arrangements are made in both designs for conduit or cable boxes, so that the cables need not be disturbed if either the main or auxiliary cover has to be removed.

The starters can, of course, be combined with oil switches to form a complete motor control unit. Interlocks are fitted so that it is not possible to close the oil switch until the starter handle is in the "off" position.

Horizontal oil-immersed drum-type controllers are designed primarily for fiery mines, but will be found equally serviceable for the control of a.c. motors in steel works, dockyards, flour mills, and similar situations where heavy demands are made upon starting gear. These controllers are made in three sizes for the control of motors from 60 to 120 h.p.; figs. 3 and 4 give a clear indication of their main features.

The whole of the working parts are contained in a stout cast-iron case, which, with its lid, is provided with the wide machined flanges necessary for flame-proof gear. The floor space occupied is a minimum, while small headroom is required.

The drum is carried in end brackets bolted to the lid; consequently, when the lid is opened the whole of the drum is "dead," and adjustments can be made without fear of shock. The drum consists of a square mild-steel shaft on which micanite has been moulded, and a cast-iron hub with projections on which are fixed the moving contacts. The hub is split longitudinally and clamped on the steel shaft; it is also divided into suitable sections, so that the necessary control operations are made possible.

The tip which makes contact with the drum is a half-round section easily renewable when required. Current is carried from the cast-iron body of the finger to the copper tip by means of copper laminations; it therefore does not pass through the spring which gives the necessary pressure to the copper tip. The clamping bolts securing these to the contact fingers are provided with spring washers so as to take up any compression that may occur in the micanised bar on which they are mounted.

The means of adjusting the pressure of the contact finger on the drum are very simple and effective. Attached to the body of the contact finger (fig. 5) is a forked brass strip. A milled nut is provided, which at one end has a square fitting into the slot. This prevents the nut from turning due to vibration or any accidental cause. If it is required to adjust the pressure on the drum, the finger is pressed back a little way and the nut adjusted and then allowed to fall back to its normal position; thus the pressure of the finger on the drum can be adjusted without the use of tools.

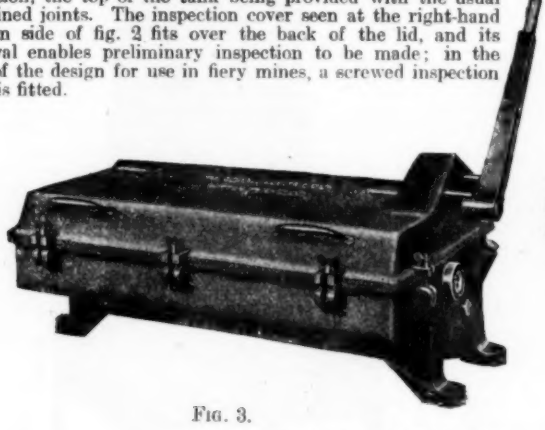


Fig. 3.

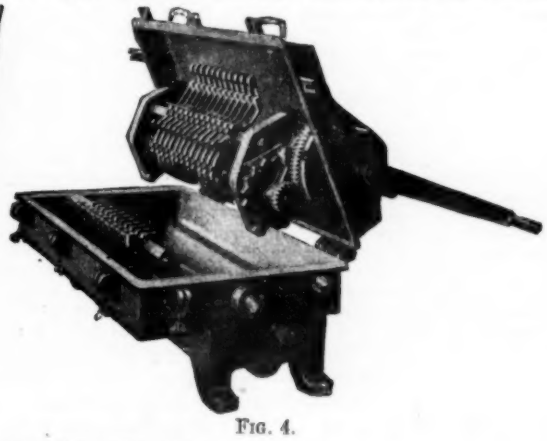


Fig. 4.

Figs. 3 & 4.—G.E.C. Oil-immersed Drum Controller.

The external connections are led in to sockets in which they are secured by "pinching-in" screws, the sockets being secured to brass contact blocks clamped to a steel rod on which micanite has been moulded. The terminal bar is in an entirely separate compartment of the case from the oil.

Contact is made between the terminal block and the controller finger by a copper tip, similar to the tip of the contact finger, and so arranged that when the lid is closed and screwed down the tip is pressed on the terminal block; it will be observed that no flexibles are used, thus dispensing with a weak link.

External connections are brought in at the bottom of the terminal compartment. Provision can be made for cable boxes, armoured clamps, or conduit, and inside sealing can also be arranged if desired, the terminal compartment being filled with bitumen for this purpose.

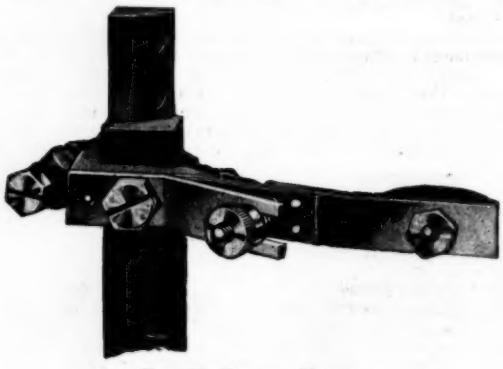


Fig. 5.—Contact Finger.

The operation is by means of a lever geared to the drum so as to prevent oil leakage through the gland. Interlocking arrangements are provided so that the controller lid can only be opened when the handle is in the "off" position. If the lid be open, it cannot be reclosed until the handle is in the "off" position. Particular attention is directed to the fact that when the controller is in the "off" position, the motor is completely isolated from the line, all three phases being broken by the controller.

These drum controllers can, if required, be combined with a pedestal-mounted oil switch so as to form a complete motor control unit and be mechanically interlocked with the oil switch. In the event of the oil switch opening when the motor is running, the controller must first be brought to the "off" position before the switch can be closed again. If desired, an electrical interlock can be supplied, as shown in fig. 6. When in the working position in either direction the lever boss presses down on the spring plunger. Should the oil switch trip when running, it is necessary to bring the handle to the "off" position, when the plunger will rise and the disk make contact between the two pins which closes the no-volt circuit on the oil switch.

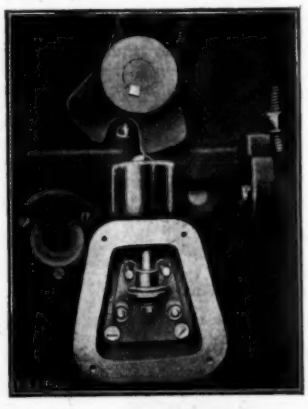


Fig. 6.—Electrical Interlock.

THE "FADE-OMETER."

A "Standardised Sunlight" Producer.

With the invention of aniline dyes, in addition to the earth pigments and old natural dyes, an infinite variety of new colours and shades became available in rapid succession, but many of them proved to be decidedly fugitive. Boiling and washing tests may be made quickly by well-known methods, but the determination of fastness to light is a much more difficult matter; the exposure of test samples to the light of the sun (providing sunlight is available) is a slow and unreliable procedure, and no test can be reproduced, the standardisation of sunlight being utterly impossible.

In 1916, the Atlas Electric Devices Co., of Chicago, U.S.A., tackled the problem and eventually produced the "Fade-Ometer," which is offered to all makers and users of coloured materials as a means of furnishing definite quantitative information on the subject of fastness to light. The device makes use of a "violet carbon arc," which is claimed to possess the maximum speed of operation and the all-important property of similarity to sunlight in fading quality. Although the light of such an arc does not look like sunlight, the violet end of its spectrum is a close reproduction of the violet end of the solar spectrum, and it is to the ultra-violet rays that the fading effect of sunlight is almost wholly due. A feature of the arc, the temperature of which is about 3,600 deg. C., is that it permits the use of an inexpensive standard glass globe about the light.

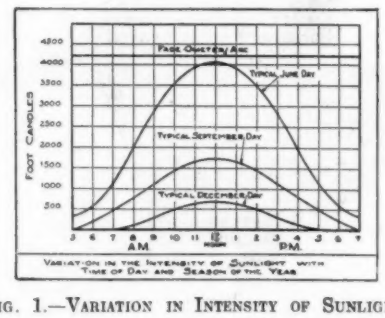


Fig. 1.—Variation in Intensity of Sunlight.

Fig. 1 indicates how the intensity of sunlight varies with the season and the time of day. In addition, different degrees

Fig. 2.—The "Fade-Ometer."

of cloudiness will add a further element of uncertainty and prevent an accurate comparison being made. An extreme example may be cited of the fading accomplished one winter by seven weeks continuous exposure to daylight being duplicated in eight hours by a "Fade-Ometer."

The arc stream plays between special electrodes and develops a spectrum that produces the same chemical reactions as sunlight, and it is claimed that the light characteristics never vary; hence the possibility of an absolute standard.

The cabinet surrounds the arc and encloses all of the controlling mechanism. It has a series of forty exposure openings equally spaced from the arc at a distance based upon a calculation of relative sun and arc light values and distances. Each exposure opening receives identically the same volume of light per unit of area, thus providing for forty identical tests at one time.

The samples to be tested are placed in individual holders fixed before the cabinet openings and arranged to cover a portion of the sample so that comparison may be made between tested and untested portions.

The cabinet is made in two sections, the lower of which can be raised for renewing the electrodes and cleaning the globe, and is constructed in such a manner that the temperature of the exposed surfaces of the samples is normal for testing purposes. Underneath the light is the humidifier filled with water. The radiant heat from the light evaporates the water and carries the vapour upward through the drum, thus maintaining the proper humidity in the region of the samples.

The current may be either direct or alternating of approximately 110 or 220 volts, but the lamp must be adjusted for the frequency desired. The electricity consumption of the "Fade-Ometer" is 13 amperes at 220 volts, or 2.86 kW, and the electrodes may be operated from 32 to 34 hours without renewal.

When ready for use, the "Fade-Ometer" occupies a floor space of 28+28 in., and is 72 in. in height; its net weight is 175 lb. without transformer, the latter weighing 40 lb.

Messrs. A. D. Lang, Ltd., are the sole agents in this country for the device, which is being used by important firms in the textile industry, and others interested in ink, printing, and coloured paper manufacture.

TRADE STATISTICS OF EGYPT.

The following statement, showing the imports of electrical and similar goods into Egypt during the year 1922, is taken from the recently-issued trade statistics. The figures for 1921 are added for purposes of comparison, and notes of any increases or decreases are given :—

	1921. £E	1922. £E	Inc. or dec. £E
Steam engines, stationary.—			
Total	7,000	2,000	– 5,000
From Great Britain	2,000	—	– 2,000
„ France	4,000	—	– 4,000
Electrical machinery and parts.—			
Total	237,000	196,000	–41,000
From Great Britain	85,000	52,000	–33,000
„ United States	12,000	1,000	–11,000
„ France	75,000	104,000	+29,000
„ Italy	15,000	6,000	– 9,000
„ Switzerland	30,000	14,000	–16,000
Internal combustion engines, stationary.—			
Total	303,000	222,000	–81,000
From Great Britain	159,000	71,000	–88,000
„ France	5,000	2,000	– 3,000
„ Italy	7,000	2,000	– 5,000
„ Switzerland	86,000	77,000	– 9,000
„ Germany	30,000	52,000	+22,000
Electric lamps, incandescent.—			
Total	48,000	53,000	+ 5,000
„ Great Britain	7,000	2,000	– 5,000
„ Germany	4,000	9,000	+ 5,000
„ France	3,000	1,000	– 2,000
„ Italy	1,000	1,000	—
„ Holland	19,000	23,000	+ 4,000
„ Switzerland	5,000	1,000	– 4,000
„ United States	3,000	—	– 3,000
„ Austria	5,000	10,000	+ 5,000
Electric lamps, arc.—			
Total	—	10,000	+10,000
Carbon rods for arc lamps.—			
Total	3,000	1,000	– 2,000
Electric cars and wagons.—			
Total	—	3,000	+ 3,000
Telegraphic and telephonic apparatus and fittings.—			
Total	112,000	73,000	–39,000
From Great Britain	88,000	58,000	–30,000
„ United States	1,000	—	– 1,000
„ France	3,000	2,000	– 1,000
„ Sweden	17,000	12,000	– 5,000
Meters, electricity, gas, and water.—			
Total	38,000	38,000	—
From Great Britain	6,000	6,000	—
„ France	22,000	26,000	+ 4,000
„ United States	5,000	1,000	– 4,000
Electric and gas pendants.—			
Total	49,000	48,000	– 1,000
From Great Britain	2,000	2,000	—
„ France	25,000	18,000	– 7,000
„ Germany	11,000	16,000	+ 5,000
Other electrical appliances and batteries.—			
Total	30,000	29,000	– 1,000
From Great Britain	8,000	3,000	– 5,000
„ Austria	1,000	2,000	+ 1,000
„ Belgium	1,000	1,000	—
„ France	3,000	3,000	—
„ Germany	4,000	13,000	+ 9,000
„ Italy	6,000	4,000	– 2,000
„ Switzerland	2,000	1,000	– 1,000
„ United States	4,000	2,000	– 2,000
Electric cables, insulated.—			
Total	90,000	80,000	–10,000
From Great Britain	38,000	18,000	–20,000
„ Belgium	4,000	4,000	—
„ France	21,000	31,000	+10,000
„ Germany	5,000	16,000	+11,000
„ Italy	16,000	5,000	–11,000
„ Japan	2,000	1,000	– 1,000
„ United States	1,000	1,000	—
Uninsulated electric copper wire.—			
Total	17,000	15,000	– 2,000
From Great Britain	8,000	7,000	– 1,000
„ France	7,000	8,000	+ 1,000
„ United States	1,000	—	– 1,000
Electric light fittings.—			
Total	83,000	93,000	+10,000
From Great Britain	19,000	14,000	– 5,000
„ Belgium	5,000	2,000	– 3,000
„ France	22,000	16,000	– 6,000
„ Germany	17,000	42,000	+25,000
„ Italy	5,000	5,000	—
„ Switzerland	7,000	3,000	– 4,000
„ United States	6,000	4,000	– 2,000

£E = £1 0s. 6½d.

The Women's Engineering Society.—In her presidential address at the recent annual meeting of the Women's Engineering Society, Lady Parsons said that the few enterprises managed and worked by women had not encountered any hindrance or opposition from men, whether trade unionists or not. Their only trouble had been lack of business experience, but they were profiting by their mistakes and learning in the school of life. Professor F. W. Burstall delivered an address, in which he stressed the need for the full consideration of the human element in industry. The meeting was attended by about 40 delegates, including French and American representatives.

Electricity in Gas Works.—In the *Gas World* a report appears of an address by Mr. P. S. Hoyte, engineer to the Plymouth Gas Co., to the Southern Association of Gas Engineers and Managers, of which he is president. Mr. Hoyte, describing the company's works, referred to the extensive use of electric power therein; previously steam power was used, and the boiler plant was taxed to its utmost capacity, for an output of 200,000 b.h.p.-hours. In 1910 two 40-kW generating sets were installed, with six motors, and the advantages of electric power were soon so much appreciated that the equipment was increased to more than 70 motors, the output being 812,000 b.h.p.-hours; nevertheless the same boilers do the work, with less fuel consumption. The cost last year was 1.11d. per b.h.p.-hour, inclusive of all charges, with coke breeze at 10s. per ton. The output of electrical energy was nearly one million kWh, costing 0.73d. per kWh at the switchboard.

THE MAINTENANCE OF VOLTAGE ON D.C. DISTRIBUTION SYSTEMS.

Discussion at Manchester.

Mr. P. J. Robinson's paper on the above subject (an abstract of which appeared in our issue of February 9th, 1923) was read at the North-Western Centre of the Institution of Electrical Engineers on February 20th, Mr. A. S. Barnard presiding.

Mr. B. Welbourn opened the discussion by remarking that the Liverpool sub-station worked well, but something simpler would have to be found before they arrived at the final solution of the problem. Therefore he repeated the appeal which he had made elsewhere for full co-operation in getting records to see which devices might be eliminated. From the cable point of view the use of the fully automatic sub-station had no terrors whatever, because no maker of apparatus could feel any satisfaction in having his products used inefficiently. Most d.c. networks were only used to approximately 40 per cent. of their capacity because of voltage drop, and devices which enabled electricity to be supplied more efficiently and cheaply could only bring additional work to all manufacturers. Semi-automatic sub-stations were in regular operation in this country 31 years ago.

Mr. Bentham said that the outlook of the automatic sub-station in this country was decidedly good. Liverpool was starting with two of them and Manchester was to follow with four. The list of items which comprised the equipment might lead one astray; probably considerably fewer than 64 pieces of apparatus would be needed.

Mr. H. A. Ratcliffe imagined that the job of the attendant at a small sub-station was one of the most monotonous and ambition-destroying that it was possible to have. For that reason there was a very big field for completely and semi-automatic equipment, which would also go a long way towards solving some of the problems in connection with railway electrification. The outstanding feature of automatic equipment was that it might do the right thing or it might not, whereas the manual operator might do many wrong things, which might in themselves be more serious than his not functioning at all. With regard to costs, figures he had considered had satisfied him that there was a good case to be made out for automatic equipment in its proper sphere, but he did not know that the figures in the paper were of very great value, because it was not possible to generalise from any one particular case, and it must not be overlooked that at the present time the cost of automatic equipment was a purely artificial one. It was desirable that automatic control should be sectionalised to some extent. That all complications could be avoided by the use of alternating current was, to some extent, true, but large direct-current systems existed, and they possessed certain very marked advantages. The automatic brush-raising gear seemed a very crude arrangement, and it was usually recognised that the less one tinkered with the brushes of the commutator the better.

Mr. G. F. Sills thought it better to protect too fully than not sufficiently until they had acquired the necessary experience. What number of relays could be dispensed with if there was no necessity to raise the brushes?

Mr. G. A. Juhlin thought that a great deal of trouble had yet to be experienced before finality was reached. It was very difficult for manufacturers to simplify their gear for the simple reason that operating engineers wanted security for the apparatus that was being installed. With rotaries which were tap started without raising the brushes, the wear and tear of the brushes was such that the average operator would not face the maintenance charge, so that the small complication of raising the brushes would be more than saved in that way. There was no difficulty in making an automatic a.c. station; in fact some were already in operation.

Mr. G. G. L. Preece said that automatic devices were sometimes put in without any regard to the capital cost. That feature would have to be watched very particularly, especially with the smaller and medium-sized stations. If they had sufficient faith in the converter plant to run it unattended it became a moot point whether they were justified in putting in automatic gear. Before very long in Manchester there would be an opportunity of comparing three different systems of completely automatic stations.

Mr. H. C. Lamb pointed out that there were some advantages which it was not usual and not advisable to mention publicly. The figures the author had given for cable laying, for manually-operating a station, and for lighting were too high.

Mr. Harcourt Williams explained that recorders were being fitted in the automatic sub-stations to record the operations of the various relays and when they failed.

Mr. Cheetham said that there was no doubt about the efficacy of the field-reversing gear. The development of automatic equipment for controlling generating stations was well on the way now in the States and would, no doubt, be adopted in Europe. Strange to say, it was very much simpler than the control of a rotary-converter station. Operating records showed that automatic stations were more reliable than manually-operated stations, and that after a shut-down (which sometimes occurred even in the best-regulated companies) the restoration of voltage was very much more rapid with automatic control.

Mr. E. Thomas thought the outstanding fact was that the description was by the purchaser and not by the maker. Everything should be of the most substantial character; having hundreds of contacts and so many relays, any one of which might upset the operation, it was of the utmost importance that they should not be treated with merely ordinary care. It would turn out to be the best type of gear to install.

Mr. A. B. Mallinson felt that there would be a field for this class of small sub-station where, instead of a rotary converter, there was a Diesel or a semi-Diesel set or a small water supply, which would automatically enable people who had no a.c. system to get over their transmission losses and to get a much bigger supply through their existing cables.

Mr. E. P. Hill pointed out that it might or might not be necessary to have brush-lifting gear with a 500-kW or smaller set. Certainly, on say a 250-kW rotary, brush-lifting gear would hardly be necessary, and consequently relatively less expensive and simpler connections were suitable. Again, for 25-cycle sets of even 500-kW capacity it would not be absolutely necessary. Tap-starting was the simplest and generally most reliable method of starting small and medium-size sets, but it necessitated that the polarity on the d.c. side should be determined definitely before the rotary was ready for load. A polarity relay was a sound proposition, but somewhat expensive, and the following method had been recently patented by the M.V. Company as an alternative. A Wheatstone bridge of Noddon valves was arranged so that the field was connected across the centre points; the outers were connected to the d.c. brushes, which pulsated during the starting period at a voltage depending on the slip of the rotary armature. The valves were connected so as to apply field current of the correct polarity from the moment of starting, or later, as desired; suitable switchgear cut out the valves when the rotary had pulled into step. It was possible to allow the rotary to build up with wrong polarity without valves, and immediately connect in on inserting the valves. As the latter were only in circuit for a few seconds they could be made very cheaply and virtually took the place of separate excitation.

Mr. J. Frith mentioned the case of the small fully-automatic private lighting plant. The fact that it was very small did not make it easier to work; it was a much more difficult problem really than the big station, because one could not afford decent relays when only spending a few pounds on the plant.

The Chairman said that he was responsible for putting down the Oxford system in Hull in well over a dozen sub-stations, all controlled from the generating station by pilot wires. The plant was run without any attention beyond what was given by a man riding round the town on a bicycle. The failure—if it was a failure—of the Oxford system in various towns in this country was certainly not due to the plant being run without attention, nor was it due to any failure of the semi-automatic switches; other inherent defects had made it fall out of use.

Mr. P. J. Robinson, in reply, said that he had not had much constructive criticism; mostly it was destructive. He agreed that when the cost of the automatic equipment could be reduced some nightshifts could, with advantage, be taken care or by full automatic control, but he was not prepared to leave the machinery running unattended. They had no trouble with the brush-raising gear; the holders of the brushes were not raised, but the carbon was raised by a cam motion within the holder or the guide. A station in America which was operated by means of two telephone wires operated on the automatic telephone system, and it was conceivable that a form of relay control could be brought into the station by simply laying a telephone service into it. In Liverpool they had always worked two men on a shift for the reason that they had had troubles in sub-stations through a man getting hurt or having a fit when left by himself. That was the basis on which he had taken the cost. Applying automatic gear to a group of rotaries would not be at all satisfactory; automatic gear had its limitations and if applied to more than two or three machines it would become very complicated.

Discussion at Edinburgh.

Mr. P. J. Robinson also read his paper at the Scottish Centre of the Institution on March 13th.

Mr. R. B. Mitchell presided in the absence of the chairman of the Centre (Mr. A. S. Hampton), and said that he agreed to the full with Mr. Robinson's idea that the cost of running long and heavy d.c. feeders was quite out of count nowadays when compared with the cost of putting down a sub-station—quite a small one—at the mid point between two

areas of supply. On that point no discussion arose. The only point which required discussion was the justification or otherwise of an automatic as compared with a manually-operated sub-station. The author gave the running charge as £1,305 for the manually-operated as compared with £255 for the automatic sub-station. It could be done for less than that. In Glasgow the smaller sub-stations were worked by a single operator per shift, and he had so far never had any reason to regret it; by making the station semi-automatic they dispensed with the night-shift man altogether, and it cost but a few pounds to add a very simple equipment. Half of £1,305 was roughly £650, and doing away with the third man reduced the figure to £440, which compared much more closely with the author's £255 than £1,305 did. So that it depended on the cost of maintaining automatic equipment, and that would be quite a high figure, perhaps more than Mr. Robinson's £93.

Prof. Francis G. Baily thought that the use of relays was a very risky proposition. The breakdown of the plant owing to some of the relays not operating would make a big addition to the maintenance costs.

Mr. A. P. Robertson pointed out that the author's was not the only system. There was another, which had only 30 relays; a reduction of 12 relays was a great advance. The tap-started rotary with a brush-lifting device would not perhaps last quite so long without trouble as a self-synchronising rotary, and it was a retrograde step to go back to the tap-started rotary. Owing to the difficulty of keeping breakers in condition, fuses were better. In the semi-automatic sub-stations in Glasgow they had no regulator, and did not find it necessary with rotary converters. In an automatic sub-station the voltage had to fall a pre-determined amount before the station came in and raised the voltage quickly; then if the load dropped off, it would go out again, when the voltage would again fall; consumers would not stand that.

Mr. O. Ellefsen explained that his experience as a manufacturer of automatic gear showed that simplicity was undoubtedly essential. When automatic gear first came into use for industrial purposes the controller had more interlocks than main contacts. It was found out later on, however, that it was a better policy to dispense with the interlocks, which resulted in more satisfactory and cheaper gear. In other schemes instead of depending entirely on relays, a master controller was used, usually motor driven; in that way a great number of relays and interlocks were dispensed with. The great variation in daylight from one day to another, or the sudden descent of a fog, might cause trouble to a sub-station controlled by a time switch only. One point which appeared to be greatly in favour of automatic sub-stations as regarded costs was that hand-operated sub-stations were undoubtedly likely to run longer on uneconomical loads than automatic sub-stations; an operator would frequently prefer to let the machine run on rather than shut down and start it up again.

Mr. E. Seddon thought, with regard to the tap-started rotary, that there were other machines on the market which would assure constant polarity and would not require the same number of relays. There was no doubt that the trend of present-day practice was to make things automatic. He could not see why Mr. Robinson should debit the manually-operated sub-station with the cost of two men. In Edinburgh they had one man per shift; it would become necessary for the safety of the attendant to arrange for a communication every hour to ensure that no harm came to him.

Mr. E. Henderson said that on a purely automatic system he could conceive a number of converters running with a load just above the setting of the low-load shutting-down relay for a fairly long period, as on the type of load mentioned on page 1 of the paper there might be clearly-defined periods of peak loads with wide valleys. This meant that the converters might operate at low loads with corresponding low efficiencies. If such sub-stations, as well as having all the purely automatic features, were also controlled by a pair of pilot cables arranged to give all the advantages of a manually-operated sub-station, the overall efficiency would be greatly improved. Also, all the sub-stations would be under the control of one engineer, which would be an advantage in the event of a serious shut down. One felt that any other method, or type of machine, which would reduce the number of devices would be very welcome, no matter how satisfactory the scheme described might be.

Mr. David Martin assured engineers who were thinking of going in for automatic rotaries that the relays described could be made "absolutely perfect."

Mr. P. J. Robinson, in reply, said that since the equipment was put into operation in August last, it had had many visitors, including every manufacturer of automatic gear in the kingdom, and demonstrations had been given of starting up and shutting down on about 300 occasions; a number of orders had been placed for similar automatic sub-station equipment. It would be as costly to lay pilot wires as cables, as a considerable portion of the cost of laying cables was that of the opening up and reinstating of the ground. He was not afraid of the relays after his experience of them. The mercury rectifier was the first thing he considered; there was a future for it, but it would have to be developed more than it was at the present. His experience of it had not been altogether disagreeable; they had a 600-ampere one working at 480 volts with satisfactory results. One disadvantage of the rectifier for automatic working was that it had a drooping characteristic of about 6¼ per cent.

POWER FACTOR: ITS TECHNICAL AND COMMERCIAL ASPECTS.

By H. E. YERBURY, M.I.E.E.

(Abstract of paper read at Bradford before the North-Midland Centre *(Leeds) of the* Institution of Electrical Engineers.)

Assuming a town with two power stations, having plant capacities of 80,000 and 20,000 kW respectively, that are interconnected by duplicate cables, each capable of carrying a load of 5,000 kW, if the power factor of 0.8 of the entire undertaking could be raised to unity, then the smaller station could be dispensed with, or would be available for supplying energy to additional consumers taking at least 15,000 kW and bringing in a net return of at least £1,500 per annum. A station of that capacity represents a capital expenditure of about £450,000.

A power factor of 0.8 calls for a 25 per cent. increase in the number of kilovolt-amperes, which means that the capacity of generators, transformers, and cables, &c., must, for the same revenue-earning load, be increased by this percentage. An improvement in power factor from the present general average of 0.7 to 0.9 would produce a 30 per cent. greater revenue-earning capacity for the same plant. It will, therefore, be readily seen that power factor has a very great influence on the cost, and therefore the selling price, of electricity. It is obvious that the consumer of power will not consider the obligation which he owes to the community in the matter of power factor unless tariffs are devised whereby he is offered a financial inducement to install plant and apparatus for its improvement. It takes far less wattless kVA to improve a power factor from 0.8 to 0.9 than to improve it from 0.9 to unity, and it takes nearly four times as great a wattless component to change the power factor from 0.8 to unity as would be required to change it from 0.8 to 0.9.

The expressions "wattless current" and "extra current" are redundant conceptions that could be dispensed with. The effect of an a.c. at its source and when split up by passing from one circuit to another and modifying the phase angle may be compared with an electrostatic field in a stationary condition and also when in motion as an electromagnetic wireless wave. In the latter condition the wave or field of force does not consist of the radiation of electric and magnetic energy, for the magnetic field is only recognised by the observer or the detector in the path of the impulse. It is not self-existing, but is a function of the electric field and only manifests itself when its velocity or kinetic energy is absorbed or detected by a receptive apparatus. An electromagnetic wave may therefore be said to have two components, one a latent potentiality and the other kinetic, the former only coming into existence when the wave passes over or through a detector designed to be affected by the latent or magnetic component of such field. In like manner, if an a.c. be split up into two components by machines or apparatus containing magnetic circuits, one in phase with the e.m.f. and the other 90 deg. out of phase, the latter is the idle or wattless component of the current. It is not a self-existing or separate entity, and should not be called "extra or wattless current." "Wattless component" is believed to be the correct expression whether of e.m.f., current, or power, although the term "reactive current" is applicable, especially where the current lags behind the voltage.

Raising the power factor over an entire system should be effected at the points where it is reduced, *viz.*, at the end of transmission lines and at or near the consumer's load. It is obviously wrong to install power-factor improving plant at a generating station. It is necessary to educate consumers, and advice should be rendered gratuitously by a supply authority to new power consumers, and where synchronous or other plant is installed which draws current at unity or leading power factor, a rebate should be allowed on each account.

Now that the Electricity Commissioners in the Electricity (Supply) Act, 1922, have repealed the section of the Electric Lighting Act of 1899, which embodied a compulsory flat rate

per kWh chargeable at the option of any consumer, a simple and equitable arrangement would be to base the tariff on the average kVA demand for a period of from 20 to 30 minutes, in order to provide for capital charges, plus a charge per kWh to cover the operating costs, with a sliding scale or basis of charge below or above the agreed standard power factor. A simple instrument is still required to integrate and record direct the average kVA during any time, as distinguished from the momentary value. The energy in kW and kVA should be separately allocated and invoiced so that a consumer may check and understand the state of his installation, and regardless of the number of meters required, no rental should be charged to power consumers.

For simplicity it is recommended that for two- and three-phase circuits two integrating watt-hour meters of the ordinary construction should be used, and the monthly power factor ascertained by the ratio of the kWh registered by these two meters.

Example.—Wattmeter reading $R_1=20$ kWh; wattmeter read $R_2=10$ kWh. Tan $\phi=(\sqrt{3})\ (20-10)/\ (20+10)=0.577$. This corresponds to an angle of 30 deg. Since cos 30 deg.= 0.866, this will be the power factor.

The maximum demand in kVA with a reasonable time lag should also be determined monthly, for if this is taken over a period of, say, 12 months, consumers refrain from using motors, &c., at certain times, so as to keep the maximum demand at the lowest figure. This is disadvantageous to a supply department, and a clause has had to be inserted in some agreements specifying that if the total price under a kVA charge proves higher than under the flat-rate kWh charge, the accounts will be invoiced at the lower rate. Where the average power factor over, say, one month has been obtained, the basic charge per kVA of demand should vary wherever the declared or standard power factor is improved or reduced.

Ignoring the usual coal clause (which, incidentally, can neither be scientific nor equitable without a standard calorific value) the ultimate price would be:—

The basic price at standard power factor (say £4 per kVA at 0.8 power factor)=standard p.f./average p.f.

Example.—Average monthly power factor=0.7 lagging; 0.8/0.7=1.14, *i.e.*, the multiplying coefficient which raises the price to £4.568 per kVA. If the supply were taken at unity power factor then £4×0.8/unity=£3.2 per kVA. Further, a rebate of 1 per cent. on the maximum-demand charge should be allowed for each 1 per cent. improvement beyond unity.

The several means of effecting an improvement of power factor should each be considered on its merits for each individual case. Every apparatus on the market may be said to have a definite field of usefulness.

An appendix to the paper gives typical examples of the application of power-factor-correcting devices and the cost of installing them.

Discussion at Bradford.

Mr. H. E. Yerbury (Sheffield) read his paper at the Bradford Technical College on March 6th, and in the absence of Mr. W. B. Woodhouse, Mr. W. Howard Brown (Shipley) presided.

In opening the discussion Mr. Buttenshaw remarked that a friend of his installed a 50-kW auto-synchronous motor coupled to a d.c. generator. It was one of the conditions under a new contract with the corporation that a compensator must be installed for raising the power factor from 0.65 to 0.8, in consideration of which it immediately gave them a reduced tariff, which approximately cut their charges 50 per cent. In addition, the machine had given them about 30 per cent. more transformer capacity, and they had found also a general improvement in the running conditions of their numerous induction motors installed in the factory.

Mr. Longman observed that some consumers, even if they were on a kVA basis, did not seem to realise what they were doing. People should be penalised for low power factor and for cable losses. Many people had been in the habit of considering that with cables it was all resistance drop, but there was quite an appreciable amount of reactance drop, even in cables. If they wanted the consumer to do anything they would have to show him that he could effect a saving. Consumers ten or fifteen miles out could not expect a supply at the same figure as those next door to the power station. Such consumers, even if they used their own plant, would have to pay a little extra for coal cartage to their premises. With regard to nomenclature, it was a pity they did not keep more to standard terms. It was bad enough in this country, but they could not pick up some of the American papers without wondering what was being talked about. He did not quite agree with the author's remarks about the transmission of large amounts of power, but he was quite right when he said "it is obviously wrong to install power-factor-improving plant at a generating station." Cutting out condensers at night might be a nuisance; it depended on what the actual current taken by the condenser was and if the consumer had a transformer on light load the condenser would about balance the magnetising current of the transformer, and so obtain a better power factor. An integrating ampere-hour meter for kVA-hour measurement had not yet been perfected. One was practically driven to the thermal demand instrument, which was cheaper and simpler, but not perfect.

Mr. Hall (Bradford) said that the consumer thought he had been penalised enough; it was up to the supply authorities to deal with the matter. Very often a man would recognise that by expending a certain amount of capital he could get a fair return, but he might not have the capital to invest. The supply authority should be in the position to spend the capital and charge the consumer for it, in which case there were many instances where it might improve power factor to the ultimate benefit both of the consumer and the supply authority.

The Chairman (Mr. Brown) observed that his point of view was, roughly, that so long as the supply authority got a power factor of about 0.8 it was absolutely satisfied. Was it to the advantage of anyone to raise it from 0.8 to 0.9? Was it not definitely up to the supply authorities to raise it from 0.8 to 0.9, which was about the highest commercial value one could go to? He was doubtful whether they wanted to raise the power factor and, as for doing anything to help one, he could not see that they were prepared to do anything at all.

He quite agreed with the necessity of disconnecting condensers at night from the supply company's point of view, but it was the customer who bought the condensers, not the supply authority. If he bought a thing he made the most use of it, and every one must look after his end of the business.

Mr. H. E. Yerbury, in replying to the discussion, agreed that reactance drop in cables was a very important matter. He had drawn his inferences from two Sheffield stations. At first sight for a power station costing £450,000 a net return of £1,500 per annum might appear to be a small profit, but a municipal concern before a net profit was earned had to put aside 6 and 3½ per cent. for the sinking fund, and an amount for depreciation. In some cases they did get over-motoring, because the motor was not put down for the average load it had to take, but for the possible maximum. A supply authority should look after its own wattless component; in an ordinary way if a low power factor was brought about by a consumer, and he knew it, he should pay for it.

PERMISSIBLE CURRENT LOADING OF CABLES.

Discussion at Birmingham.

Messrs. S. W. Melsom and E. Fawsett presented their report on the above subject (which was abstracted in our issue of March 9th, 1923) at the South Midland Centre of the Institution of Electrical Engineers on April 4th.

Mr. H. W. Blades, in connection with the expansion of cables, instanced a case that occurred a short time ago of a number of cables under abnormal war conditions gradually slipping for a distance of 4 ft. down a long gradient for a total distance of approximately 500 yd., but by taking advantage of the expansion of the cable when loaded and by means of suitable clamps and straining devices, the cables were persuaded to creep up the stiff gradient until they were back again in their original position, and this, of course, was accomplished whilst the cables were carrying full load. Regarding the statement "that a cable drawn into a conduit is free to move lengthways along the duct and cause injury to the lead by abrasion," from observations and tests on a large conduit system the chief trouble was found to be not so much the abrasion of the lead in contact with the duct, as how to accommodate the expansion of the cables and so prevent ripples in the lead, cracked plumbs, &c., in the joint pits. The linear expansion resulted in a longitudinal movement of the cable at the bell mouth, but by suitable bends in the cable at the joint pit this longitudinal movement was changed into a lateral movement of the joint box. The joint itself was mounted on special cradles, which had frictionless qualities, and the whole joint was free to move in a transverse direction. These joints were in a state of continual movement and had been working successfully for several years in this manner without showing any signs at all of deterioration of the lead.

Mr. W. E. Groves thought that the information in the report was exactly what the mains engineer needed. As the permissible current loading was generally governed by the maximum temperature which could be attained without damage to the dielectric, it was hoped that more definite information would be forthcoming on this point. The thermal resistivity of the dielectric would be obviously constant throughout a cable length, but in considering a long run of main the safe loading would depend on the worst patch of ground that it passed through from the point of view of thermal resistivity; consequently, in determining the load rating of the cable before laying, the least favourable conditions must be assumed. In this connection one would expect that the nature of the paving would affect the moisture content of the ground. Modern methods of treatment of roadways rendered the surface practically impervious to moisture and the surface water was much more thoroughly drained to the sewers. This limitation due to expansion was emphasised in the writing down of the permissible temperature of cables in conduits by 15 deg. C. in order to avoid abrasion of the lead. This appeared to be hardly justified if the internal surface of the conduit was

smooth and well lubricated when the cable was drawn in. At any rate, it seemed too high a price to pay, and one would rather risk a little, as the damage would be more local than that caused to the cable by over-heating of the dielectric.

Major A. M. Taylor was glad that the authors had emphasised the fact that the reciprocal of the capacity (termed by Karapetoff the "elastivity") was related to the geometrical dimensions of the cable in a precisely similar way to the thermal resistance. The remarks relating to the difference in expansion between the armouring of the cable and the lead sheathing of the copper indicated that there were forces tending to buckle the copper conductor directly a point of minimum mechanical strength was reached. Such a point would occur where the cable approached a junction box, and might take place in the junction box itself. He knew of a case where the copper had been crushed and forced into contact with the box itself by this action. The tremendous forces that obtained must result either in the armouring being inordinately strained or else the copper unduly compressed, and it was not inconceivable that, due to the worming of the three conductors, a tendency to sudden bending might occur in parts of the cable itself, and would be sufficient, even though in appearance very slight, to crack the insulation and start a weak point, which would develop into a fault. This pointed to the advantage of, if possible, doing without the armouring altogether, a course which was adopted in the Gennevilliers cables.

Table 16 gave a current of 328 amps. for a 0.25-sq. in. cable (concentric and armoured), while in table 21 a current of 34 amps. was given for a precisely similar cable, but with the difference that the latter was insulated for 11,000 volts, whereas the former was only insulated for 660 volts. One would have expected that the thermal resistance of the 11,000-volt cable would have been much higher than that of the 660-volt cable, demanding a very much smaller, rather than a larger current.

Table 28 gave a figure of 620 for the resistivity of cable No. 3 and a figure of 1,060 for the resistivity of cable No. 4. There seemed no obvious reason for this tremendous difference. Again, the statement that "examination of the experimental values for different types of cable showed that generally the lower-pressure cables had a thermal resistivity somewhat greater than the higher-pressure cable," and the remarks that followed seemed to suggest that this effect was due to questions of cost. Was it in any way due to the fact that with the higher insulations there was a much greater distance through which impregnation had to take place, and was it possible that the impregnation was less perfect in the higher-voltage cables? In dealing with triple-concentric cables it was stated that if the load were assumed to be carried by the two inner conductors only the current for a given temperature rise would be 5 per cent. less than that for an "equivalent" size of concentric cable with two conductors only. What would be the result if the innermost and outermost conductors had been considered when the intermediate conductor was carrying no current? His impression was that the greater the amount of heat that could be liberated towards the circumference of the cable the lower would be the temperature of the innermost core. The word "equivalent" used by the authors should be defined. Did they mean by this the same cross-section for each of the two "outer" cores, or did they mean a cross-section such that the same power could be conveyed with the same total amount of copper at an equal voltage across the "outers"?

In table 1 particulars were given which required further elucidation, and he thought that the figures in heavy type (*viz.*, 340, 180, 120, 90) should preferably be 227, 120, 80 and 60.

JOINTS IN ALUMINIUM AND COPPER BUSBARS.

The efficiency of joints in busbars is a matter of great importance in view of the heavy currents to be dealt with in large power stations, but few reliable data have been published on this subject. A paper communicated to the *Journal* of the Institution of Electrical Engineers last year, however (by Messrs. S. W. Melsom and H. C. Booth), went far to fill up the gap.

The authors gave the results of an investigation carried out at the National Physical Laboratory on various forms of clamped joints between flat conductors of rectangular cross-section. The effect of stream-line distortion at the overlap was found to be an increase of resistance of 20 per cent. as compared with that of the solid bar, when the length of overlap was four times the thickness, falling to 4 per cent. when the ratio was 10 to 1. The contact resistance was nearly inversely proportional to the area of contact when the pressure per unit of area was constant. Tests were made on both aluminium and copper bars, pressed together by an hydraulic ram. In the case of aluminium it was found that the easiest method of preparing the bars under practical conditions, namely, rough cleaning with a file, coating with vaseline, and cleaning with emery, or coating with vaseline and rough filing, in both cases leaving the dirty vaseline on the bars, was at least as good as any other method.

Copper also gave the best results when the surfaces were coated with vaseline, and the values obtained with a joint pressed together after cleaning with vaseline were as good as when the joint was soldered. The interposition of layers of tinfoil between the surfaces was detrimental to the efficiency, and no advantage was gained by roughening the surface of the bar with a file, rubbing with vaseline and emery being the best method of preparation. The pressure produced by clamps and bolts was found to be the equivalent of from 1,000 to 2,000 lb. per sq. in. With thin bars, as ordinarily used, the localised pressure produced by the bolts appeared to strain the metal sufficiently to bring about a more intimate contact than would be the case with thick bars.

In the case of aluminium bars 3 in. wide and 7-16 in. thick, roughened and coated with vaseline and cleaned with emery, the overlap being 3 in., four ⅜-in. brass bolts gave an initial contact resistance of 1.4 microhms, the whole joint resistance being 3.18 microhms—practically identical with that of the solid bar. Four ½-in. steel bolts gave a slightly lower resistance. Copper bars 1 in. x ¼ in., clamped together with a ⅜-in. steel bolt, having an overlap of 2 in., gave a contact resistance of 2.25 microhms and a joint resistance of 5 microhms; with an overlap of 1 in. the contact resistance was 0.89 microhm and the joint resistance 2.35 microhms—in each case slightly less than the resistance of the same length of bar. With 6-in. x ¼-in. copper strip, having an overlap of 3 in., and held together by two ⅜-in. bolts, the contact resistance was 0.35 to 0.39 microhm and the joint resistance 0.73 to 0.76 microhm, about equal to that of the solid strip. With an overlap of 6 in. and four bolts, the joint resistance was about two-thirds that of the solid strip.

From the results obtained by Messrs. Melsom and Booth it appears that average values of contact resistance under normal joint pressure (2,000 lb. per sq. in.) may be taken as 10 microhms per sq. in. for aluminium and 4.2 microhms per sq. in. for copper. Taking these values, the British Aluminium Co. points out that the length of overlap to give a joint of 100 per cent. efficiency should be as follows:—

Thickness of Bar.	Length of Overlap. Aluminium.	Copper.
¼ in.	3.1 in.	2.8 in.
⅜ in.	2.7 in.	2.3 in.
½ in.	2.2 in.	1.9 in.
3-16 in.	1.9 in.	1.6 in.

These figures show that only a very small overlap is required to give a perfect joint in aluminium, and it is interesting to note the very small difference between the overlap required with copper and aluminium bars. In most practical cases a much greater overlap than the figures in the table would be necessary for purely mechanical reasons, and it follows that joints in aluminium and copper busbars would normally have well over 100 per cent. efficiency.

A Combustion Film.—Mr. Charles Erith, A.M.I.Mech.E., exhibited on April 11th to a meeting of the Electrical Power Engineers' Association, at Liverpool University, a kinematograph film showing the actual processes of combustion in a large modern boiler, at loads varying from banked fires to about 9 lb. of steam per sq. ft. heating surface.

The large boiler was fitted with a "Riley" moving-grate, retort-type stoker, carrying a thick bed of fire, the incandescent surface of the entire fuel bed radiating direct to the boiler tubes, as no furnace arches are required with this firing system, in which the fuel bed is progressively advanced, and the incombustible ash is continuously discharged, at all rates of combustion, by the "Riley" conveyor-tuyères or moving grates. The stoker shown was exactly similar to the one recently ordered for a large new boiler at Worcester Corporation electricity works, being four times the capacity of the first "Riley" stoker installed, which has now been seven years in use. Reference was made to very large "Riley" stokers in British, French, American, Indian, Australian, Chinese and Japanese power stations under all types of water-tube boilers.

Mr. Erith described the methods of protecting the lens of the camera, whereby it had become possible to obtain a satisfactory picture of combustion at a furnace temperature of 3,000 deg. F.; and how, by snapping pictures at intervals, so that four hours of actual stoker operation are shown in only two minutes, the actual motion of the coal through the furnace is clearly shown on the film, though its travel is too slow for ordinary observation. The film showed how, in only six minutes, starting from banked fires, the rate of combustion was increased until the boiler duty was brought up to 70,000 lb. of steam hourly, or about 9 lb. actual steam per sq. ft., corresponding to 300 per cent. on American boiler rating, by merely increasing the speed of the stoker and varying the draught pressures of the fans.

The film is to be seen at the offices of the company, Palace Chambers, Bridge Street, S.W.1.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A New Hardness Tester.

Messrs. Edward G. Herbert, Ltd., Atlas Works, Chapel Street, Levenshulme, Manchester, have developed a new instrument for testing the hardness of materials ranging from lead to sapphire. It is especially applicable to hardened steels. The instrument dispenses with all microscopic measurements, and, as it does not depend upon impact, the readings are in no way affected by the mass or inertia of the specimen.

The construction is very simple. A ball, 1 mm. in diameter, is held in a chuck in the centre of the instrument, and six screwed weights are provided whereby the position of the centre of gravity of the whole instrument may be adjusted to coincide with the centre of the ball, which is of ruby or steel. Immediately above the ball is a graduated weight mounted on a screw. By raising or lowering this weight the

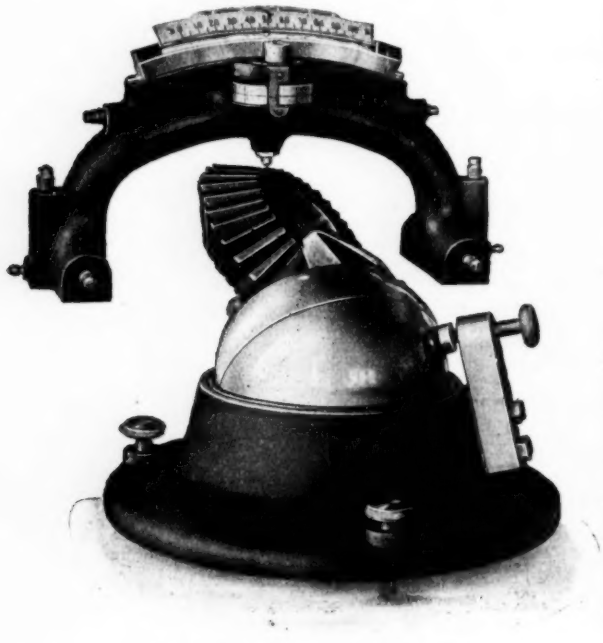


Fig. 1.—A New Hardness Tester.

centre of gravity of the instrument can be brought to a predetermined distance above or below the centre of the ball. The graduations on the weight show displacements of the centre of gravity in hundredths of a millimetre. A curved tube and bubble and a scale graduated from 0 to 100 are fixed at the top of the instrument. The centre of gravity being at the centre of the ball, the instrument is in neutral equilibrium when supported by the ball on a hard level surface. It tends to remain in any position in which it may be placed, whether upright or tilted. If the centre of gravity is above the centre of the ball the equilibrium may be unstable, in which case the instrument tends to "lie down" in one direction or another. If the centre of gravity is below the centre of the ball, the equilibrium is stable. The instrument constitutes a pendulum oscillating about its central position, the time of oscillation being greater as the length of the pendulum (the distance between the centre of gravity and the centre of the ball) is less.

Both scale and time tests can be carried out by means of this device. In the former test, if the instrument is tilted to the right until the bubble is at 0 in the scale and is placed in that position on a very hard level surface and released, it will swing pendulum fashion, the oscillations gradually decreasing in amplitude owing to the expenditure of energy at the point of contact between the ball and the hard surface. The amplitude of the oscillations is shown by the bubble and scale. On plate-glass the bubble travels from 0 to 97 in the first oscillation. This gives an indication of the hardness of the substance.

Another way of using the instrument is to measure the time in seconds taken by 10 swings of the pendulum. This gives a "time-hardness" number. For glass this is 100; for tempered high-speed steel, 52; and for lead, 3. For most purposes the time tests are recommended.

Fig. 1 shows the application of the instrument to the testing of a cutter in a ball chuck.

The "Ruston" Cold Starting Oil Engine.

Messrs. Ruston & Hornsby, Ltd., of Lincoln, are making a range of vertical oil engines whose principal feature is their ability to start from "cold," *i.e.*, without the use of a blow lamp or other external heating arrangement. The adoption of a high-compression pressure renders the starting of the engines very reliable, and prevents the dangerous high starting pressures due to the misfiring of the charge experienced in some engines of the lower compression type. The system of fuel injection and atomisation excludes the use of mechanically-operated fuel valves and high-duty air compressors, and by the Ruston system it is impossible for the fuel to be delivered to the cylinder before the actual time at which it is required. Thus pre-ignition is avoided. The engines are controlled by a centrifugal-type governor, and a hand speed regulator is also fitted.

The economy of the engine is high. The consumption, with average working conditions and fuel, does not exceed .44 lb. in the smallest and .42 lb. in the largest engines per b.h.p.-hour. The range of oil which may be used in these engines is wide, and includes tar oil, residual, crude, and refined oils.

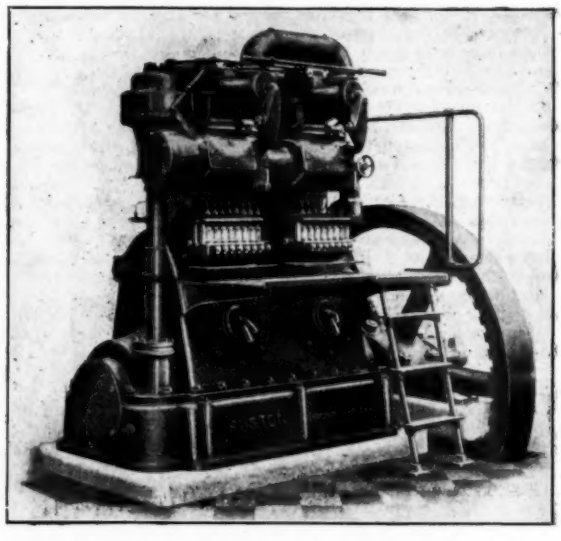


Fig. 2.—110-b.h.p. 'Ruston" Cold Starting Engine.

Eight sizes are made, ranging from 55 to 550 b.h.p., equivalent to electrical outputs of from 32 to 350 kW. The engine illustrated in fig. 2 is the 110-b.h.p. size. This has two cylinders and operates at a speed of 300 r.p.m., having a working capacity of 66 kW.

The "Eye-Restolite" System.

In the "Eye-Restolite" lighting system brought out by the British Thomson-Houston Co., Ltd., Crown House, Aldwych, W.C.2, the aim is to provide a general diffused illumination from the ordinary silk shaded floor or table standard, in addition to the downward local light, and only a single lamp is employed. The unit consists essentially of an "X-Ray"

Fig. 3.—The "Eye-Restolite" Lighting Fitting.

reflector above and a diffusing bowl below, the lamp being held between the two. The major part of the light is thrown upwards by the reflector, but local illumination, sufficient for reading and close work, is diffused downwards by the glass bowl. This diffused light also serves to illuminate the silk shade. The exterior surface of the X-ray reflector is white enamelled to enhance the illumination of the silk shade. The lower end of the " Eye-Restolite " is threaded for attachment to any ordinary floor or table standard. Three sizes are made for gasfilled lamps of 100 W, 150 W, and 200 W, the first being fitted with a b.c. holder and the two larger sizes with E.s. holders. The " Eye-Restolite " fitting gives an adequate and absolutely glareless general illumination combined with a higher local intensity, for reading or writing, all from a single lamp, without detracting in any way from the decorative appearance of the standard and silk shade.

CORRESPONDENCE.

Letters received by us **after 5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Contractors and Broadcasting.

I note with interest a paragraph in your leading columns under the heading " Contractors and Radio," for therein you confirm points which I raised in a previous communication, addressed to several trade journals at the time when electrical contractors were complaining that the sale of radio apparatus had been diverted from them into the hands of other businesses having little or no connection with electricity.

In the earlier letter above referred to, I emphasised the importance of having a good working knowledge of that branch of electrical science covering the design and use of radio instruments, and suggested that contractors would be well advised to join their local radio society or wireless club.

The articles by Mr. Harris will doubtless go a long way towards helping the electrical contractor to appreciate and understand the theory of the apparatus in question; nevertheless it is certain that after reading these articles the contractor will desire to ask a great many detailed questions, all of which could be answered by the technical representatives of his local society.

Some two years ago the Radio Society of Great Britain arranged a list of professional members who were willing to lecture and demonstrate the principles of wireless in any part of the country, and I have no doubt that this arrangement could be extended so that local contractors' associations might, when necessary, take advantage of the services of these members, and arrangements could be made to give lectures in any local hall or school. In this way the public interest could be fostered and maintained to the benefit of enterprising electrical contractors.

L. F. Fogarty.

Uxbridge, *April 11th*, 1923.

Architects and Electrical Contracts.

Is every town cursed with a large population of architects whose methods of getting their electrical contracting done entirely disregard all questions except those of price?

The general methods of business in this town are well instanced by the following case:—A new bungalow is being built by Messrs. X, architects; 15 lighting points are to be installed, one in a garage about 20 or 30 yards from the house. The five largest rooms are all to be wired for radiators, but when asked how large, Messrs. X say: " Oh, enough to heat the rooms." The rooms are not small, and the length of twin cable is 500 ft. for lighting and 250 ft. for heating. Messrs. X send particulars of the building to all the electrical contractors they happen to think of. No specification is provided, and none is asked for; the total price is all that counts. In this case they got the job done for £18 12s. 6d.

Another architect in the same town boasts that he gets his lighting work done for 11s 2d. per point, inclusive of switch, flex, shade, and lampholder.

Perhaps one of the latest wiring systems accounts for these prices—if so, will the owners of the system please reveal themselves?

Devonian.

Exeter, *April 6th*, 1923.

Faults in Wiring.

I have read with interest the article in your current issue by Mr. K. F. Bishop, on one reason for faults in electrical wiring.

While I agree that the suggestions put forward are very valuable, and in my experience have been attended with excellent results, I think the writer has omitted one very important point, and I should be glad if he would be good enough, in his next article, to say what happens to the exposed end of the copper, as he does not appear to suggest any means of protecting this from damp and corrosion, and I think your readers will appreciate that it would be no use making a good job and preventing moisture creeping up the conductors, if the ends of the conductors are left exposed to trouble.

J. C. White.

Manchester, *April 16th*, 1923.

Wireless Hints.

I have been much interested in the excellent articles by Mr. Percy W. Harris. They are full of practical information based on experience. One of the extraordinary things about wireless is the conflicting experience of users of receiving sets. Mr. Harris, speaking of aerial heights (p. 567) says: " It must be borne in mind that it is not so much the height above the ground that counts, but the height *above the instruments*." Now, my aerial consists of 15 ft. of single 16 S.W.G. fixed under the ceiling of my top room, and is about 4 ft. above the instrument, which is a 2-valve set. Reception of 2LO is practically perfect. By way of experiment to see if I could pick up more and so reduce my filament current, I dropped a wire from the window to a garden fence on the ground, the wire making an angle of about 45 deg. with the short horizontal indoor aerial. All the outside aerial, except about 4 ft., is below the instrument, but notwithstanding this, I am able to obtain the same result as before with a smaller current.

Frank Broadbent.

Coulsdon, *April 16th*, 1923.

The Training of Young Engineers.

Further, to my letter dated March 28th, *re* the training of young engineers, which you were kind enough to publish in the April 6th issue, I should like to say a little on one point that I think is likely to disturb the minds of many.

I understand that so far the students that have been entered for the course of training under the Newcastle-upon-Tyne scheme are men who have had a University training, and some, if not all, have taken their degrees.

I have no fault to find with the University men, and I certainly think that they should receive the utmost attention with regard to the opportunity of a practical training, but it would seem as if it is to be an exclusive scheme and that the man from the workshop will find it a long road to the " top," or anywhere approaching the " top."

Many men, after having had practical experience, turn their attention to the correspondence school with a view to becoming technically trained, and settle down to study with the hope of future success. If, however, the " top " positions are for University men who have gone through a practical training scheme, then what of the correspondence schools, polytechnics, and the like?

Of course, these schools do not depend upon the engineering profession alone, but the training schemes might easily spread to many professions; the schemes again might become exclusive, and it is more than likely that other large engineering concerns will consider the question of training men for the responsible positions.

The point in question is the future of those men whose ambition urges them to make an effort to improve their knowledge, and who hope to obtain promotion—but what of the feelings of these men when they find the door locked and the only way to obtain the key is through the University?

A few months ago, I took up a technical course with a well-known school, but, unfortunately, became unemployed almost immediately, and of course I had to give up the course of study for the time being. I regret to say that I am unable to make a fresh start, as I am still unemployed.

I have been wondering since following the question of the training of young engineers, whether it will be worth my while to proceed with the technical course, and I think that many will hesitate before spending their money, and give the question considerable thought.

If the scheme for training young engineers is to be an exclusive one—which I trust is not the case—many who emanate from the workshops will have a nasty taste in their mouths.

N. O. Chance.

April 14th, 1923.

Relativity.—According to Dr. Campbell, director of the Lick Observatory, and head of the American expedition to observe the eclipse last September, the photographic records of the apparent positions of stars close to the sun's disk confirm the theory of relativity developed by Prof. Einstein. At a meeting of the Royal Astronomical Society, on Friday last, Prof. Eddington stated that three separate expeditions had now given the same result, and he felt convinced that the above conclusion was right.

NEW PATENTS APPLIED FOR, 1923.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Patent Agents, 285, High Holborn, London, W.C. 1.

9,022. "Cable telegraphy." Western Union Telegraph Co. March 29th. (United States, October 23rd, 1922.)
9,031. "Electron discharge apparatus." British Thomson-Houston Co., Ltd. March 29th. (United States, April 8th, 1922.)
9,035. "Electric switches." C. G. Bennett and L. W. Bennett. March 29th.
9,042. "Connections or terminals for electric circuits." J. Roberts. April 3rd.
9,053. "Method of utilising force of attraction between two charged plates of electric condenser." R. H. Barton and L. C. Munn. April 3rd.
9,056. "Earth clip for electric apparatus." W. Mavitta. April 3rd.
9,073. "Electric heating plates." A. Low & Sons, Ltd., and W. E. Miller. April 3rd.
9,098. "Manufacture of electric cables." E. A. Bayles and British Insulated and Helsby Cables, Ltd. April 3rd.
9,111. "Aerials for wireless telegraphy, &c." J. H. Wilkins. April 3rd.
9,121. "Electric circuit-breakers, &c." H. W. Clothier, B. H. Leeson, and A. Reyrolle & Co., Ltd. April 3rd.
9,130. "Electric resistances or rheostats." G. W. Harris and C. Seymour. April 3rd.
9,137. "Secret intercommunication by oscillatory discharges." L. D. G. Morrison. April 3rd.
9,148. "Intervalve transformer, &c., for wireless signalling, &c." S. J. Anderson. April 3rd.
9,153. "Device for use with wireless receivers." S. L. Forbes and Wireless Agencies, Ltd. April 3rd.
9,167. "Mounting coils for wireless telegraphy, &c." G. E. Morley. April 3rd.
9,168. "Apparatus for wireless telephony, &c." G. E. Morley. April 3rd.
9,172. "Variable inductance for wireless receivers." V. Crabb. April 3rd.
9,178. "Stowage devices for electric lamps, &c." Britannia Folding Box Co., Ltd., and G. G. Pickard. April 3rd.
9,179. "Contact shoes for electric traction." V. Tricerri. April 3rd.
9,186. "Hydrometers for testing electric accumulators." W. Torrance. April 3rd.
9,187. "Three-valve receiving apparatus." J. Junker. April 3rd.
9,188. "Combined high- and low-frequency amplifying device." J. Junker. April 3rd.
9,194. "Electrically-operated transportation apparatus." Continuous Transit Co. April 3rd. (United States, May 15th, 1922.)
9,219. "Inductance coils." J. F. Bennett. April 4th.
9,223. "Crystal-detector holder." F. C. Clark. April 4th.
9,247. "Basket coils for radio-telephony, &c." J. S. Rowe. April 4th.
9,252. "Push-button lifts, &c." Waygood-Otis, Ltd. April 4th. (United States, May 24th, 1922.)
9,267. "Trumpet for wireless telephony." M. A. E. Splinden. April 4th.
9,281. "Electric lamps." F. O. Monkhouse and G. E. Tate. April 4th.
9,314. "Generating electro-magnetic waves." D. W. Rees. April 5th.
9,318. "Telephone receivers." British L.M. Ericsson Manufacturing Co., Ltd., and A. G. Rogers. April 5th.
9,326. "Wireless receiving instruments." H. P. Rees. April 5th.
9,328. "Electrically conductive clips." H. E. Walker. April 5th.
9,335. "Sound-magnifiers for wireless receiving sets." C. G. Garrard. April 5th.
9,344. "Electrically-operated locks." J. Sowerby. April 5th.
9,353. "Coil windings for wireless reception, &c." A. H. Midgley. April 5th.
9,356. "Direct-current mercury motor electricity meters." Ferranti, Ltd., and S. Z. de Ferranti. April 5th.
9,358. "Machines for insulating armature windings." W. E. Moore. April 5th.
9,361. "Electric cooking-plates, &c." N. Magelssen. April 5th. (Norway, April 6th, 1922.)
9,367. "Neutralising capacity coupling between electric circuits." W. J. Mellersh-Jackson (Independent Radio Manufacturers, Inc.). April 5th.
9,375. "Electrically-driven freezers, &c." F. C. Austin, F. Pooley, M. A. E. Splinden, and W. L. Wreford. April 5th.
9,400. "Electrically-controlled apparatus." Aktiebolaget Birka Regulator. April 5th. (Sweden, April 6th, 1922.)
9,401. "Signalling systems." Marconi's Wireless Telegraph Co., Ltd. April 5th. (United States, April 17th, 1922.)
9,402. "Neutralising capacity coupling between electric circuits." W. J. Mellersh-Jackson (Independent Radio Manufacturers, Inc.). April 5th.
9,410. "Crystal detectors." S. L. Price. April 5th.
9,413. "Wireless broadcasting." Skinner Organ Co., Inc. April 5th. (United States, February 8th.)
9,419. "Valves for wireless telegraphy, &c." A. J. Kemp. April 6th.
9,424. "Crystal detector." W. Howlett. April 6th.
9,431. "Wireless receiving sets." Abbey Industries, Ltd., H. Melville-Smith, and S. J. Tyrrell. April 6th.
9,432. "Wireless crystal receivers." Abbey Industries Ltd., H. Melville-Smith, and S. J. Tyrrell. April 6th.
9,433. "Wireless aerials." Abbey Industries, Ltd., H. Melville-Smith, and S. J. Tyrrell. April 6th.
9,434. "Wireless receiving sets." Abbey Industries, Ltd., H. Melville-Smith, and S. J. Tyrrell. April 6th.
9,435. "Valves for wireless apparatus and incandescent electric lamps." C. T. Rhodes and H. Wood. April 6th.
9,448. "Earphone holder." F. Harrington. April 6th.
9,451. "Receiving apparatus for wireless signalling." R. M. Abraham. April 6th.
9,486. "Switchboards for charging accumulators." A. S. Barnes. April 6th.
9,489. "Mounting electric lamps on vehicles." H. A. Suttle. April 6th.
9,490. "Damping device for switch contacts for electro-magnetic vibrating members." A. H. Maitre and V. H. G. Martin. April 6th. (France, April 12th, 1922.)
9,492. "Crystal detectors." W. E. Hackett. April 6th.
9,501. "Slow-acting relays." Western Electric Co., Ltd. (Rutten). April 6th.
9,502. "Loaded transmission systems." Western Electric Co., Ltd. (Western Electric Co. Inc.). April 6th.
9,503. "Telephone exchange systems." Western Electric Co., Ltd. (Western Electric Co. Inc.). April 6th.
9,508. "Rupture of electric currents." C. Chilowsky and J. Saphores. April 6th. (France, February 12th.)
9,527. "Aerials for wireless telegraphy, &c." L. Barber and J. Parkinson. April 6th.
9,534. "Electric switches." Hart Manufacturing Co. April 6th. (United States, February 24th, 1922.)
9,536. "Frame aerial for wireless reception." W. Beresford. April 7th.
9,551. "Receptors and inductance coils for wireless telegraphy, &c." G. F. Woods and R. S. Woods. April 7th.
9,564. "Electric fires." F. L. L. Calvert and C. F. Linton. April 7th.
9,579. "Moving electric sign." F. C. Reilly. April 7th.
9,584. "Crystal detector." G. E. Marbaix. April 7th.
9,589. "Electric heating elements." A. Brown. April 7th.
9,593. "Circuit-changers for tabulating machines, &c." British Tabulating Machine Co., Ltd., and W. Partington. April 7th.
9,596. "Telephone systems." W. D. Edwards, Relay Automatic Telephone Co., Ltd., and R. G. Vanneck. April 7th.
9,597. "Aerials for wireless telegraphy." C. K. Chandler. April 7th.
9,600. "Variable inductance devices." A. D. Cowper. April 7th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1921.

25,279. "Junction boxes for electrical connections." A. H. Midgley. September 23rd, 1921. (195,106.)
27,868. "Carrier telegraph circuits." Western Electric Co., Ltd. October 21st, 1920. (170,584.)
28,196. "Telephone exchange system." Western Electric Co., Ltd. October 25th, 1920. (170,600.)
30,850. "Printing telegraphy." Western Electric Co., Ltd. (Western Electric Co. Inc.). November 18th, 1921. (195,121.)
31,271. "Liquid-cooled electric machines." M. Seidner. December 29th, 1917. (172,015.)
31,537. "Wireless direction-finding apparatus." Ges. fur Drahtlose Telegraphie. December 14th, 1920. (172,942.)
34,041. "Insulating stands and holders or plugs for holding coils for use in electrical apparatus." G. H. Moody and H. D. Butler. December 17th, 1921. (195,134.)
34,125. "Apparatus for cooling and ventilating dynamo-electric machines." W. Bartel and O. Happel. December 20th, 1920. (172,983.)
34,345. "Electric rail bonds." H. T. Tudsbery and P. Groom-Johnson. December 21st, 1921. (195,144.)
34,518. "Electromagnetic relays and the like." Western Electric Co., Ltd. (Western Electric Co., Inc.). December 22nd, 1921. (195,152.)
34,628. "Electrical lighting circuits for motor vehicles or other purposes." Standard Motor Co., Ltd., R. W. Maudsley, and F. A. Johnson. December 23rd, 1921. (195,160.)
34,871. "Process for setting rotating electric meters." Dr. O. T. Blathy. April 14th, 1920. (173,518.)
34,898. "Electric or like timing device." J. R. Bell. December 29th, 1921. (195,168.)

1922.

719. "Electrically-heated kettles and similar vessels." Hague & Mackenzie, Ltd., and A. Hague. January 10th, 1922. (195,185.)
1,207. "Incandescent electric lamps." J. T. Robin. January 13th, 1922. (195,194.)
1,281. "Electricity meters." Chamberlain & Hookham, Ltd., and S. James. January 14th, 1922. (195,196.)
1,460. "Electrical switchgear." W. A. Coates and Metropolitan-Vickers Electrical Co., Ltd. January 17th, 1922. (195,198.)
1,494. "Hot-wire microphones." W. S. Tucker and E. T. Paris. January 17th, 1922. (Addition to 138,368.) (195,199.)
2,517. "Telephone systems." Western Electric Co., Ltd., and G. Deakin. January 27th, 1922. (195,209.)
4,959. "Time-lag electric switch." R. S. Allen. February 20th, 1922. (195,237.)
5,236. "Electrical switchgear." Metropolitan-Vickers Electrical Co., Ltd. June 30th, 1921. (182,434.)
5,411. "Alternating-current machines." H. Frei. February 23rd, 1921. (175,995.)
5,662. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. March 16th, 1921. (177,154.)
6,709. "Electrical switches." D. Tinlot. March 7th, 1922. (195,249.)
6,849. "Electro-therapeutic apparatus." R. Araya. March 8th, 1922. (195,251.)
7,105. "Current-collecting apparatus for use on electric railways or tramways." A. A. Bull. March 10th, 1922. (195,254.)
7,142. "Element for storage-battery cells." E. Varé. March 10th, 1921. (176,801.)
7,674. "Electric lighting systems used on motor vehicles or elsewhere." E. W. Reed. December 9th, 1922. (195,258.)
8,381. "Electrical condensers." W. H. Goodman and Dubilier Condenser Co. (1921), Ltd. March 22nd, 1922. (195,266.)
9,326. "Telephone repeater systems." Western Electric Co., Ltd. (Western Electric Co., Inc.). April 3rd, 1922. (195,273.)
17,171. "Tables for supporting wireless telegraphic or telephonic installations." P. Hemardinquer. March 21st, 1922. (195,310.)
18,057. "Electrically-insulating pipe section for high-vacuum pipe lines." Akt. Ges. Brown, Boveri et Cie. September 30th, 1921. (186,582.)
19,306. "Device for improvement of the electric ignition in explosion motors." E. von Lepel. July 21st, 1921. (183,451.)
20,580. "Resistance devices." Ward Leonard Electric Co. March 27th, 1922. (195,318.)
20,581. "Resistance devices." Ward Leonard Electric Co. March 28th, 1922. (195,319.)
23,337. "Electric incandescent lamps." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. August 30th, 1921. (185,410.)

1923.

2,757. "Apparatus for the evacuation of electric incandescent lamps and the like." General Electric Co., Ltd. February 1st, 1922. (192,695.)
4,131. "Method of cooling turbine-driven dynamo-electric machines." W. Bartel and O. Happel. December 20th, 1920. (Divided application on 172,983.) (193,056.)
6,421. "Electric relays, particularly for use in metering telephone calls." A. J. Wheeler. December 14th, 1921. (Divided application on 194,766.) (Cognate application 7,314/23.) (Divided application on 9,401/22.) (195,029.)

Post Office Staff Reorganisation.—Staff reorganisation in the Post Office is taking place, says the *Manchester Guardian*, which indicates that amongst the changes that are to take place telegraph business is undergoing much alteration. High-speed instruments will connect the larger towns. The smaller towns will have all telegraphy removed, and the telephone will connect them to the nearest centre. This will enable telephonists, who can be taught the duty of dictating messages by telephone in a short time, to replace skilled telegraphists, and economy will result. The telephones and telegraphs will be placed more directly under the control of men possessing a specialised knowledge of these subjects. There will be no pretence that the postmaster or surveyor knows anything of the business, and dual interference will be eliminated.